SILVACO

TonyPlot 3D
User's Manual

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Style Conventions		
Font Style/Convention	**Description**	**Example**
•	This represents a list of items or terms.	• Bullet A • Bullet B • Bullet C
1. 2. 3.	This represents a set of directions to perform an action.	To open a door: 1. Unlock the door by inserting the key into keyhole. 2. Turn key counter-clockwise. 3. Pull out the key from the keyhole. 4. Grab the doorknob and turn clockwise and pull.
→	This represents a sequence of menu options and GUI buttons to perform an action.	**File→Open**
`Courier`	This represents the commands, parameters, and variables syntax.	`HAPPY BIRTHDAY`
New Century Schoolbook Bold	This represents the menu options and buttons in the GUI.	**File**
New Century Schoolbook Italics	This represents the variables of equations.	$x + y = 1$
Note:	This represents the additional important information.	**Note:** Make sure you save often while running an experiment.
NEW CENTURY SCHOOLBOOK IN SMALL CAPS	This represents the names of the SILVACO Products.	ATHENA and ATLAS

Table of Contents

Chapter 1: Introduction

1.1: Overview

TONYPLOT3D is a 3D graphics viewer, capable of displaying data generated from 3D process and device simulators. It also allows you to control labeling, lighting, shading and other plot aspects.

This chapter will explain its applications, assuming TONYPLOT3D is properly installed. More detailed information on installing TONYPLOT3D and proper operation on each platform can be found in the Appendix A: “Operating Platforms”. Figure 1-1 shows TONYPLOT3D when it’s first loaded.

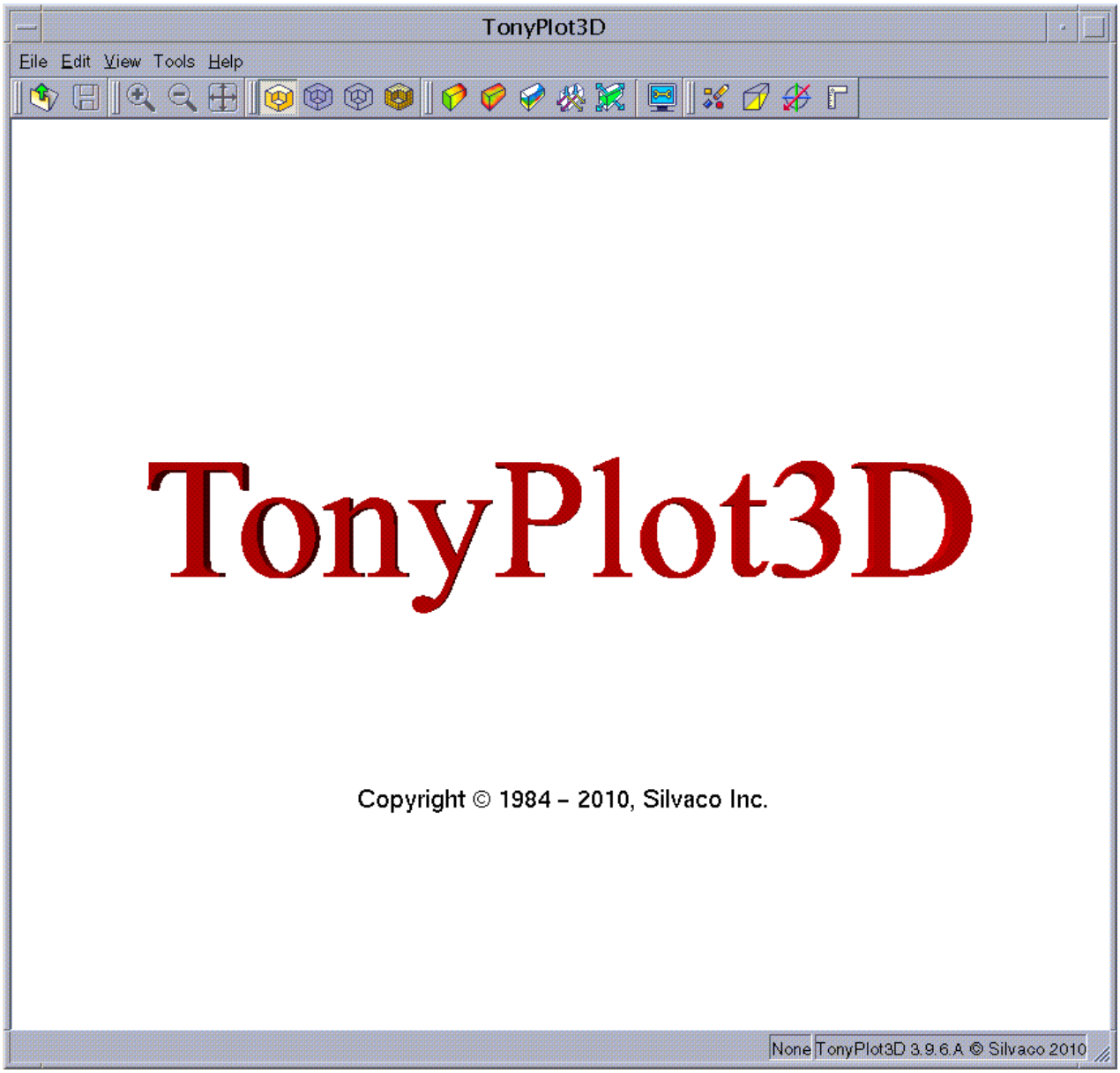


Figure 1-1: TonyPlot3D Title Screen

1.2: Differences Between TonyPlot3D and TonyPlot

TONYPLOT3D only loads and displays 3D data. It doesn't, however, recognize or display 2D data. TONYPLOT, consequently, doesn't recognize 3D files. Sometimes, TONYPLOT may load 3D files and display a cross section of the data. This behavior, however, isn't supported and shouldn't be expected for all 3D files.

While TONYPLOT is capable of loading and displaying several data sets simultaneously, TONYPLOT3D can only show one data set, which means you can only load one file at a time. Whenever a new file is loaded, the old plot is replaced with the new one.

1.2.1: Starting TonyPlot3D

To start TONYPLOT3D, type:

```
tonyplot3d
```

As with TONYPLOT, the data file name that is being loaded can be supplied immediately.

Note: The filename shouldn't begin with a minus (–) character.

Table 1-1 shows a set of command line arguments that can be specified.

Table 1-1: TonyPlot3D Command Line Arguments

Command Line Option	Description
`-buffer[single|double]`	Specifies the buffering mode to use when drawing the 3D Scene (i.e., `single` or `double`).
`-help`	Display the command line options in the standard output.
`-nohw`	Forces TONYPLOT3D to avoid using any hardware graphics accelerators that may be available on the computer. By default, TONYPLOT3D tries to use any acceleration it can find. More information about various graphics hardware can be found in Appendix A: "Operating Platforms".

Chapter 2:
Using TonyPlot3D

2.1: Main Window

When TONYPLOT3D is started, the Main Window should appear. Initially, the main window displays a TONYPLOT3D banner with copyright information. Clicking on the banner will start spinning the 3D text. Click in the Plotting Area again to stop the movement. The layout of the Main Window is shown in Figure 2-1.

The Main Window provides a number of drop down menus and shortcut toolbars to access the features provided within TONYPLOT3D. Table 2-1 describes the different areas of the Main Window.

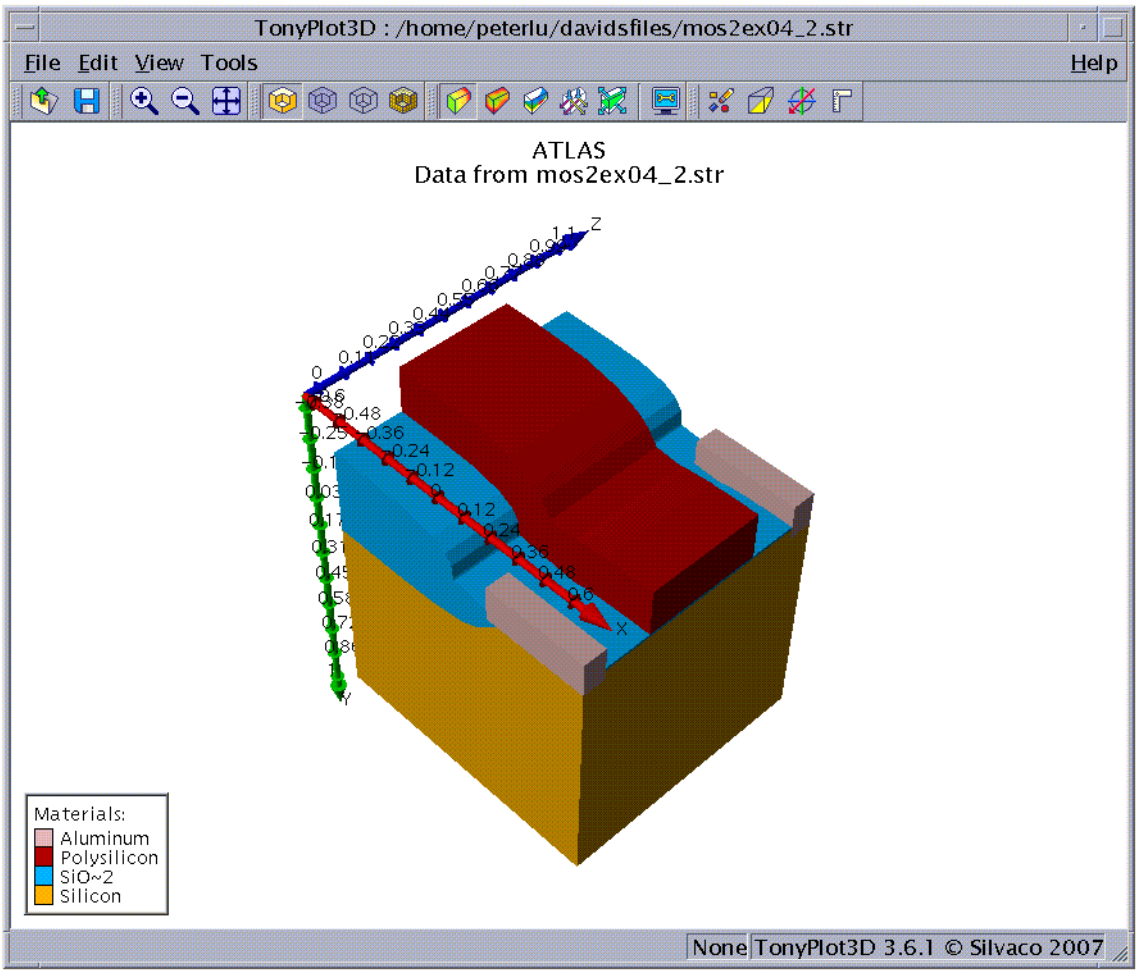


Figure 2-1: Main Window

Table 2-1: Main Window Options	
Option	**Description**
Main Menu	The menus along the top of the TONYPLOT3D window provide access to pop-ups, switches and toggles. These provide detailed control over the display and setup. Some menu options have "hot-keys." These hot-keys are denoted with an underscore. Use these hot-keys to directly access the features. To use the hot keys, press the ALT key simultaneously with the identified hot key letter (i.e., the underscored letter). Once you do this, press the denoted hot-key letter to access a specific option. For example, to open the **Display** option in the View menu, press: **ALT** and **V**, followed by **D** only.
Main Toolbar	This toolbar complements the pull down menus by providing quicker access to most frequently used options.
Plotting Area	The central portion of the main window is used to display data. In this plot area, the mouse pointer can be used to manipulate the plot.
Plot Control Toolbar	This toolbar provides quick access to controls that change the way the plot area displays the data (i.e., zoom & view transformations).

2.1.1: Main Menu Options

Table 2-2: Main Menu Options		
Menu Title	**Option**	**Description**
File	**Open**	A file browser will appear that allows you to load a 3D structure file.
	Save As Surface	Saves all the faces of the 3D elements as triangles in a `.str` file.
	Load Set File	This resumes the previous setting including cutting plane, camera position, zoom, light, material color, contours, and isosurface.
	Save Set File	Saves the current setting information. The setting file function can easily help you to restore the previous setting and plot results. You can also use the command to generate predefined pictures or results, such as `tonyplot3d structure.str -set myset.set -png structure.png`.
	Export to File	Exports the bitmap of the Plotting Area in various file formats, such as bmp, pbm, and png. The size of the saved file matches the size of the Plotting Area.
	Recent Files	Loads the recent `.str` file.
	Exit	Exits from Tonyplot3D

Table 2-2: Main Menu Options		
Menu Title	**Option**	**Description**
Edit	**Properties**	Edits visibility, opacity, and draw mode.
	Hide	Hides selected object.
	Opaque	Sets selected object opaque.
	Transparent	Sets selected object transparent.
	Preferences	**Manage Preferences**: Manages Preferences, such as import, export application preferences, and reset application preferences. **Application**: Edits Toolbars and Shortcuts settings. **Rendering**: Edits Fonts, Colors, and Legend settings. **Settings**: Edits Mouse and Dialogs settings. **Viewing**: Edits Axis, Camera, Lights, and Structure settings.
	Materials	Edits Materials.
View	**Zoom Full**	Centers the structure in the Plotting Area with a pre-defined pose matrix.
	Zoom In	Zooms into the current structure display.
	Zoom Out	Zooms out of the current structure display.
	Show From	The **Show From** option has sub-options. These sub-options are: **Top**, **Bottom**, **Front**, **Back**, **Left & Right**. All these sub-options simply move the current display structure to display it from the selected position.
	Solid	Shows all the exterior faces of the object.
	Meshed	Shows the mesh of external faces.
	Edge	Shows only the exterior sharp edges of the object.
	Solid and Meshed	This is a combination of the Solid and Meshed Modes.
	Regions	See Section 2.3.1: “Regions”.
	Contours	See Section 2.3.2: “Contours”.
	IsoSurface	See Section 2.3.4: “Isosurface”.
	Rays	See Section 2.3.3: “Rays”.
	Vectors	See Section 2.3.5: “Vectors”.
	Display	Opens the Display Modes Window. This is used to change the display mode and viewing parameters.
Tools	**Cut Plane**	Starts the Cutplane Tool and shows the 2D cut as it would be exported to TONYPLOT.

Table 2-2: Main Menu Options		
Menu Title	**Option**	**Description**
	Object Browser	Displays a hierarchy of the objects in the current scene and structure.
	Probe	Starts the Probe Tool and shows the picked object using the left mouse button.
	Ruler	Starts the Ruler Tool and shows the quantities of the picked object using the Control key and the left mouse button.
Help	**About Tonyplot3D**	Shows TONYPLOT3D version information.
	TonyPlot3D Help	Displays the user's manual for TONYPLOT3D (PDF format).
	Release Notes	Displays the release notes for TONYPLOT3D (PDF format).

2.1.2: Main Toolbar Options

Table 2-3: Main Toolbar Options		
Icon	**Name**	**Effect**
	File Open	A file browser is displayed that allows you to load a 3D structure file.
	Save As Surfaces	Saves all the faces of the 3D elements as triangles in a `.str` file.
	Zoom In	Zoom into the structure.
	Zoom Out	Zoom out from the structure.
	Zoom Full	Centers the structure in the Plotting Area with a pre-defined pose matrix.
	Solid	Shows all the exterior faces of the object.
	Meshed	Shows the mesh of external faces.
	Edge	Shows only the exterior sharp edges of the object.

Table 2-3: Main Toolbar Options		
Icon	**Name**	**Effect**
	Solid and Meshed	This is a combination of the Solid and Meshed Modes.
	Regions	See Section 2.3.1: “Regions”.
	Contours	See Section 2.3.2: “Contours”.
	IsoSurface	See Section 2.3.4: “Isosurface”.
	Rays	See Section 2.3.3: “Rays”.
	Vectors	See Section 2.3.5: “Vectors”.
	Display	Opens the Display Modes Window. This is used to change the display mode and viewing parameters.
	Object Browser	Displays a hierarchy of the objects in the current scene and structure. Once this hierarchy is displayed, you can then perform actions such as Hide or Show. For more information about the Object Editor, see the Section 2.4.1: “Object Browser”.
	Cutplane	Starts the Cutplane Tool and shows the 2D cut as it would be exported to TONYPLOT.
	Probe	Starts the Probe Tool and shows the picked object using the left mouse button.
	Ruler	Starts the Ruler Tool and shows the quantities of the picked object using the Control key and the left mouse button.

2.1.3: Plot Control Using the Mouse

Within the Main Window, you can use the mouse to move the structure. You can adjust the functions of the mouse by using the Mouse Interface (see "Mouse" section on page 2-44 for more information).

There are six different movements you can apply to the structure: rotation (which has three modes), translation, zoom, and scaling.

Rotation

The left-button rotates the structure at the center of its bounding box. Shift and the left-button rotates from the point where the click originated in the 3D scene. Shift and the middle-button rotates the structure from an axis going out of the screen and from the middle of the viewport.

Translating

To translate (move) the plot, hold down the middle-button while dragging the mouse. The plot will then move in response to the movements of the mouse.

Zoom

To zoom, use the right-button. This is essentially a translation applied on an axis going out of the screen. Very different from the scaling, since the vertices of the structures aren't modified.

Scaling

To scale a plot, hold down the Shift key and use the right-button. The scale can be applied independently in the X, Y and Z directions (for more information, see the **Scaling** option in the Camera Interface on page 45). A scaling is applied to the vertices. This movement is useful when one dimension of the structure has to be scale to see its details. This happens when viewing very thin structures.

Automatic Movements

You can rotate, translate, zoom, and scale automatically by releasing the mouse button just before stopping the mouse for any of the above mentioned operations. To enable automatic movements, check the **Automatic Movements** box in the Mouse Interface. See "Mouse" Section on page 44 for more information.

Note: The bounding box will only appear if you activate it in the Struct Interface. See "Structure" section on page 2-47 for more information.

2.2: Material Colors

TONYPLOT3D now can change the material colors and save the modified materials. To increase compatibility, it now uses the same default material color information as TONYPLOT. After loading a structure file, you can select **Edit→Materials** to open the Materials Dialog. Figure 2-2 shows a structure file with default material colors. Figure 2-3 is the Materials Dialog.

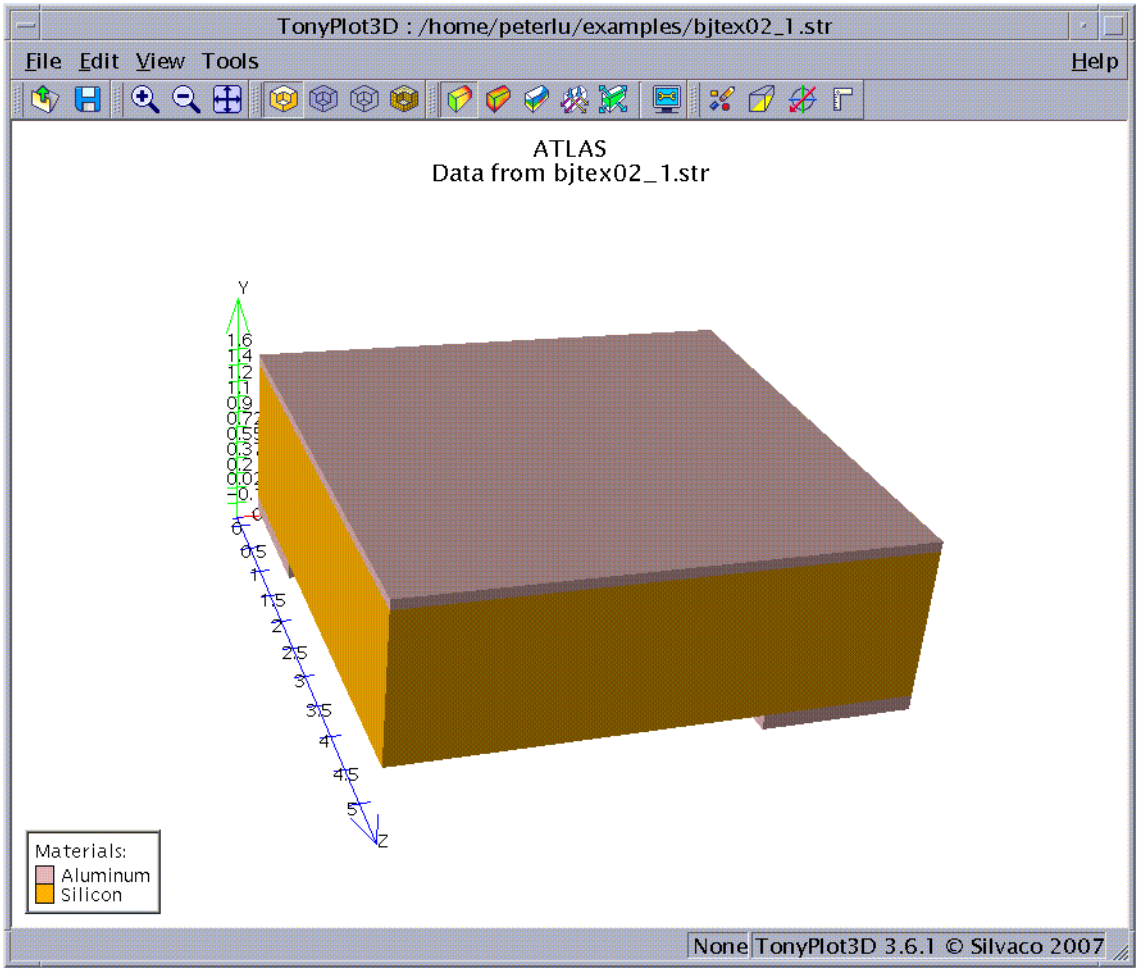


Figure 2-2: A Structure File with Default Materials

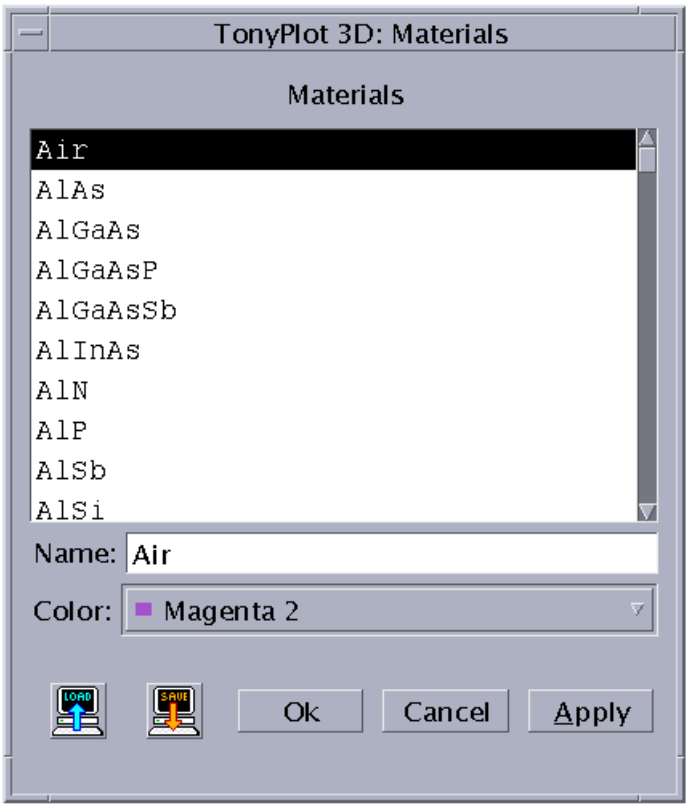


Figure 2-3: Materials Dialog

To change the material **Aluminum** to **Blue 5**, for example, first highlight the material name **Aluminum,** then choose the **Blue 5** in the color palette, and click **Apply**. Then, do the same for the material **Silicon**. The aluminum and silicon materials will change their colors accordingly (see Figures 2-4, 2-5, and 2-6).

You can also click  on the Materials Dialog to save the modified materials. It actually sets the overriding values in `$HOME/.silvaco/material.info` or `$HOME/.simucad/material.info`. Figure 2-7 shows one structure file with the modified silicon and aluminum materials.

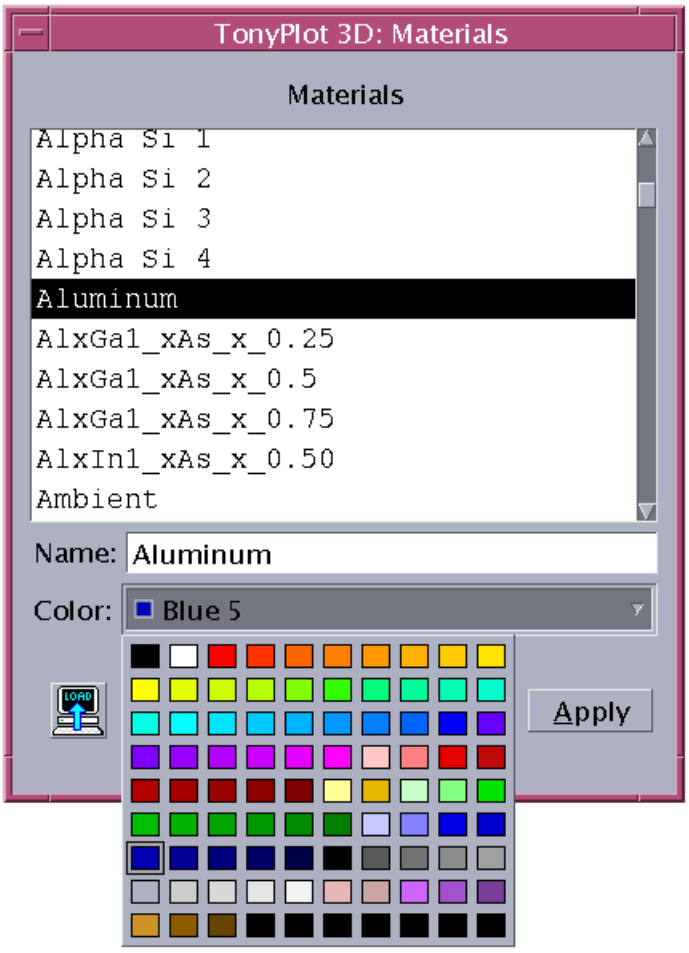


Figure 2-4: Changing the Material Color Aluminum

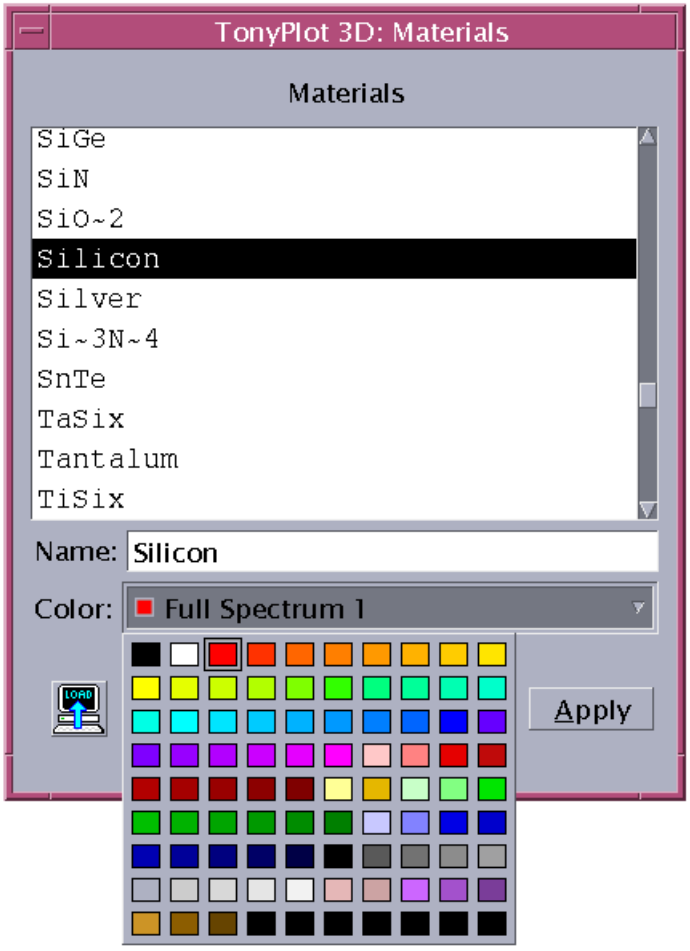


Figure 2-5: Changing the Material Color Silicon

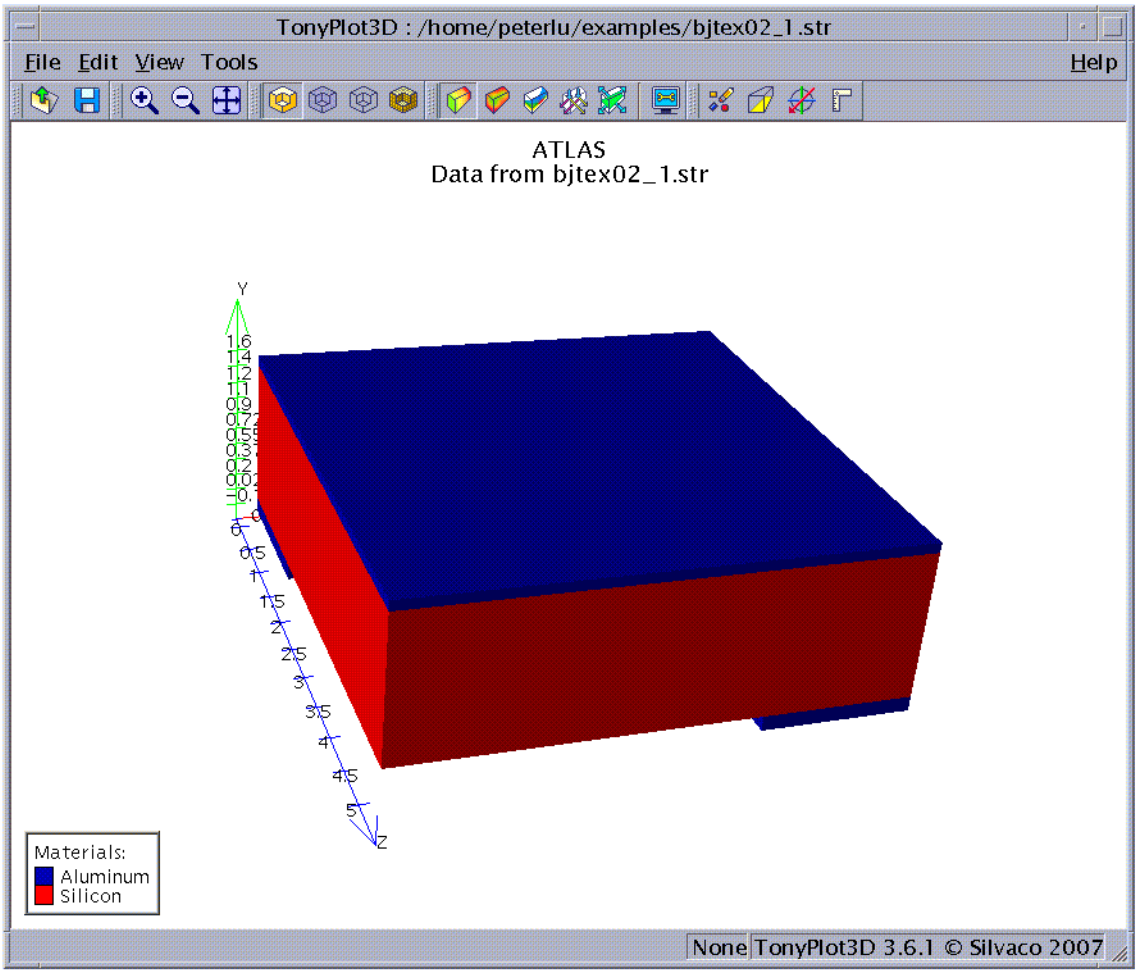


Figure 2-6: The results of material colors changed

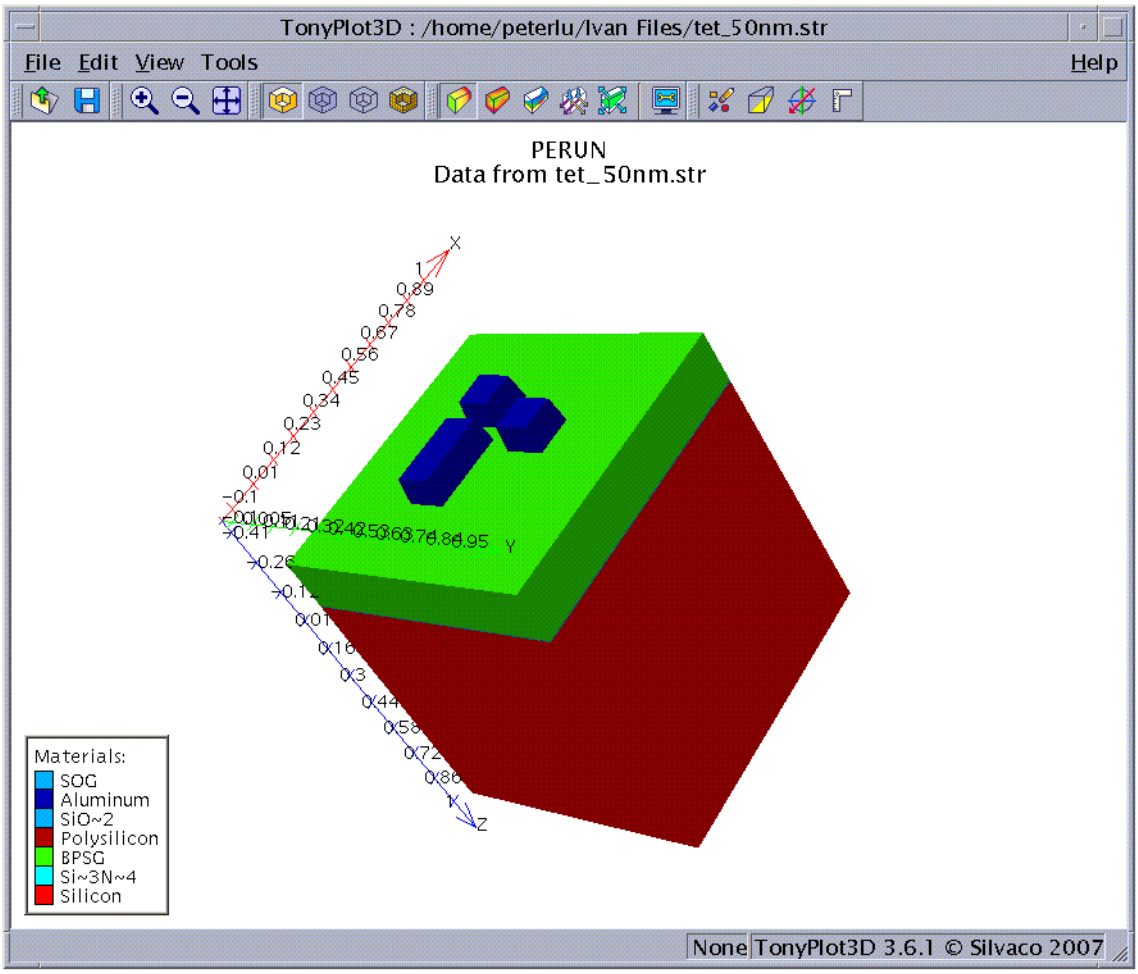


Figure 2-7: One structure file with Silicon and Aluminum changed

2.3: Display Modes

Under the **View** menu bar, there are five different display modes: **Regions**, **Contours**, **Rays**, **Isosurfaces**, and **Vectors**. You can select all these display modes at the same time. To activate a display mode, simply click its menu.

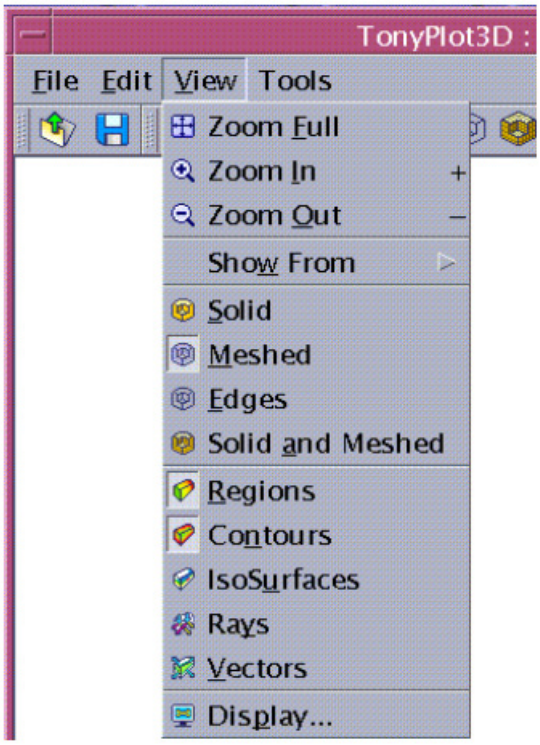


Figure 2-8: Display Modes Window

To further configure the appearance of the plot, select **View→Display…→Display Mode**. The Display Properties will appear with additional settings for each mode (see the next subsections for more information on these settings). Choose the tabs relevant to the mode you want to configure. Don't forget to click on the **OK/Apply** button to apply your changes. When using these settings, make sure you turn on the relevant display mode.

There are four Draw Mode menus (**Solid**, **Meshed**, **Edges**, and **Solid and Meshed**) that control the way the faces of a structure are displayed. Table 2-4 describes these modes.

Table 2-4: Draw Modes		
Icon	**Mode**	**Description**
	Solid Fill	The solid fill mode shows all the exterior faces of the object.
	Edges Only	In this mode, only the exterior sharp edges of the object are shown.
	Mesh	This mode shows the mesh of the external faces by default. You can change this mode to display all the mesh in the structure or in a volume specified by a cylinder. The possible settings are: **Faces**, **Elements** (tetrahedra or prisms), or **Volume** (Cylinder). See Figure 2-9.
	Solid Fill With Mesh	This is a combination of the solid fill mode and the mesh mode (i.e., it fills all the cells that make up the object).

To further configure the appearance of the mesh of the structure, choose the **Options** menu in the lower section of the Display Modes Window. The Draw Mode Options Dialog shown in Figure 2-9 will appear.

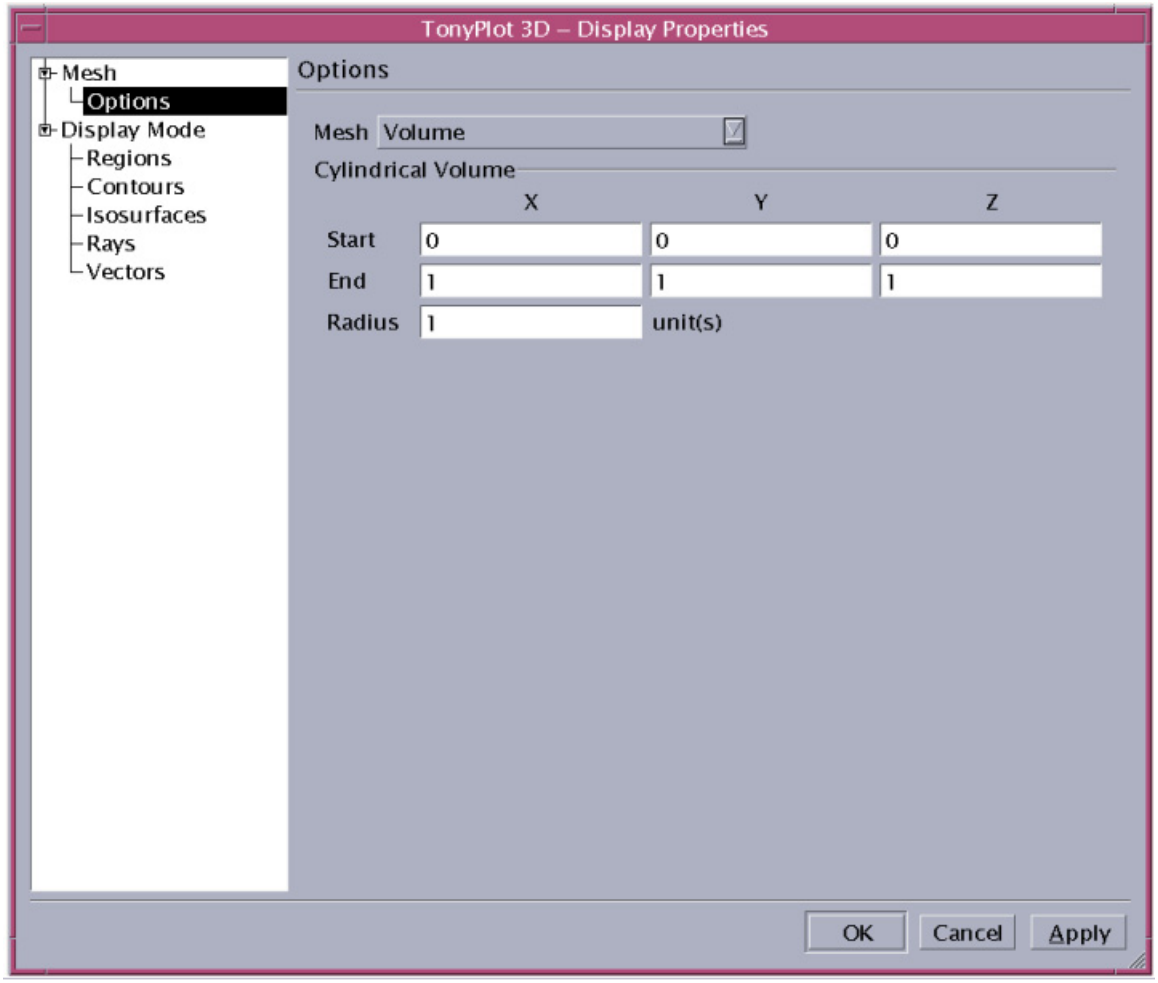


Figure 2-9: Draw Mode Options Dialog Box

Table 2-5 shows the different options available in the Draw Mode Options Dialog.

Table 2-5: Draw Mode Options Dialog Box

Option	Description
Face	Draws the mesh for the surface of the regions only.
Element	Draws the mesh for all the elements (3D).
Volume	Draws the mesh in the specified cyclindrical volume. Use the **X**,**Y**,**Z**, and **Radius** fields to specify the cylindrical volume.

2.3.1: Regions

The Region Display Mode (Figure 2-10) is the default display mode. If you select **Material**, each material will be assigned a color. If you select **Region**, one color will be assigned to each region in the data. In either case, a legend is provided to show each color assigned to material or region names.

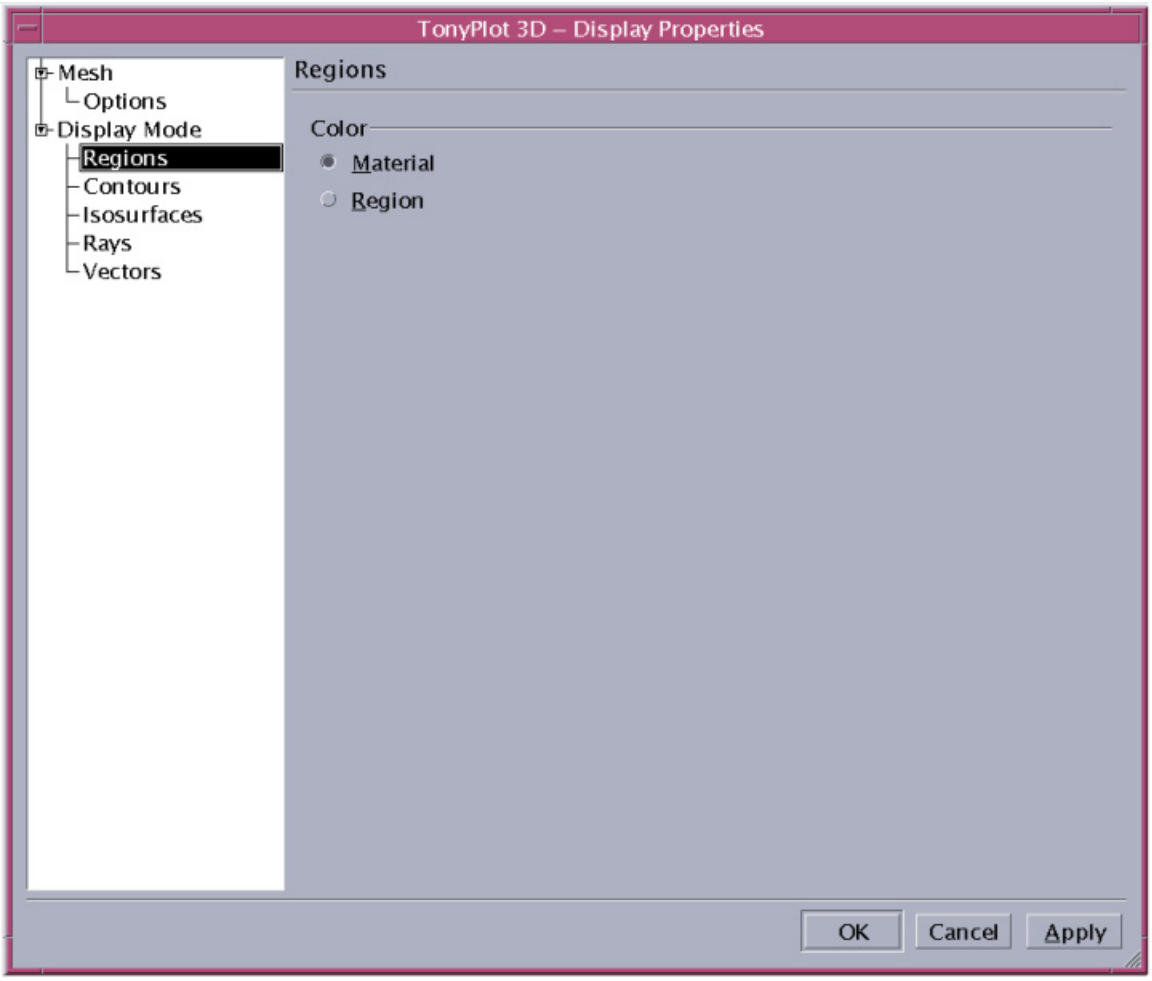


Figure 2-10: Regions Display Mode

2.3.2: Contours

The Contour Display Mode is shown in Figure 2-11. Contours are shown as a colorization of the exterior faces of an object. Contours are drawn only on exterior portions of the structure. Figure 2-12 shows an example of these contours. To observe the inside values perform a cutplane (see Section 2.4.2: “Cutplane” for more information).

The **Quantity** option box holds all of the quantities present in the data set. Choose one of these quantities for contouring.

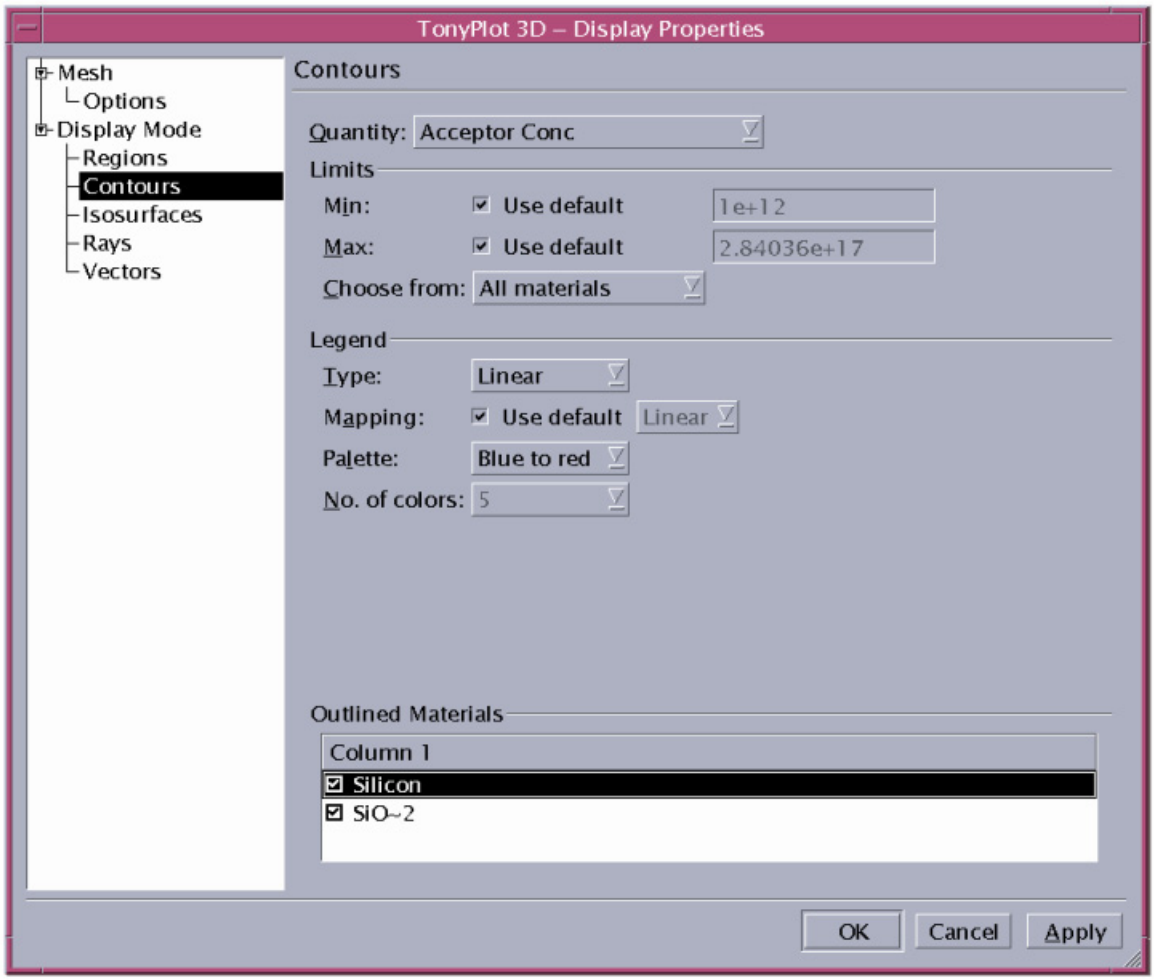


Figure 2-11: Contours Display Mode

Data Constraint Settings

The **Limits** Group Box controls the data range used in the contours legend. If you set **Min** and **Max** to **Auto**, then TONYPLOT3D extracts the data range from the different materials of the structure. You can use the pulldown menu **Choose From** to change the materials used in the computation of this data range. The three choices are: **All Materials**, **Outlined Materials** and **Selected Objects**. **All Materials** is the default settings. In this mode, all the nodes in the structure are used to find out the data range. If **Outline Materials** is selected, then the list of highlighted materials in the **Outlined Materials Group Box** are chosen. If **Selected Objects** is selected, the data range is computed from the list of selected objects in the scene (see Section 2.4.1: "Object Browser"). The limits can also be user-defined by turning on the **Use default** button and specifying the **Min** and **Max**.

The **Legend** Group Box controls the way the contours are drawn on the faces. If you use **Linear Type**, the colors will linearly interpolate between the reference colors of the legend. The **Stepped Type** will produce a finite number of colors to use within the data range. This mode is very useful for color-blind users. The **Palette** and **Nb Colors** are also available to further change the appearance of the legend.

The quantity values can either be plotted with a linear or logarithmic scale. When the mapping is linear, the values are directly mapped to the legend's colors. When the mapping is logarithmic, the log10 is taken before the mapping occurs. Figure 2-11 shows an example of logarithmic mapping for the Donor Concentration. The default mapping is chosen by TONYPLOT3D but can be overridden by using the **Use default** button.

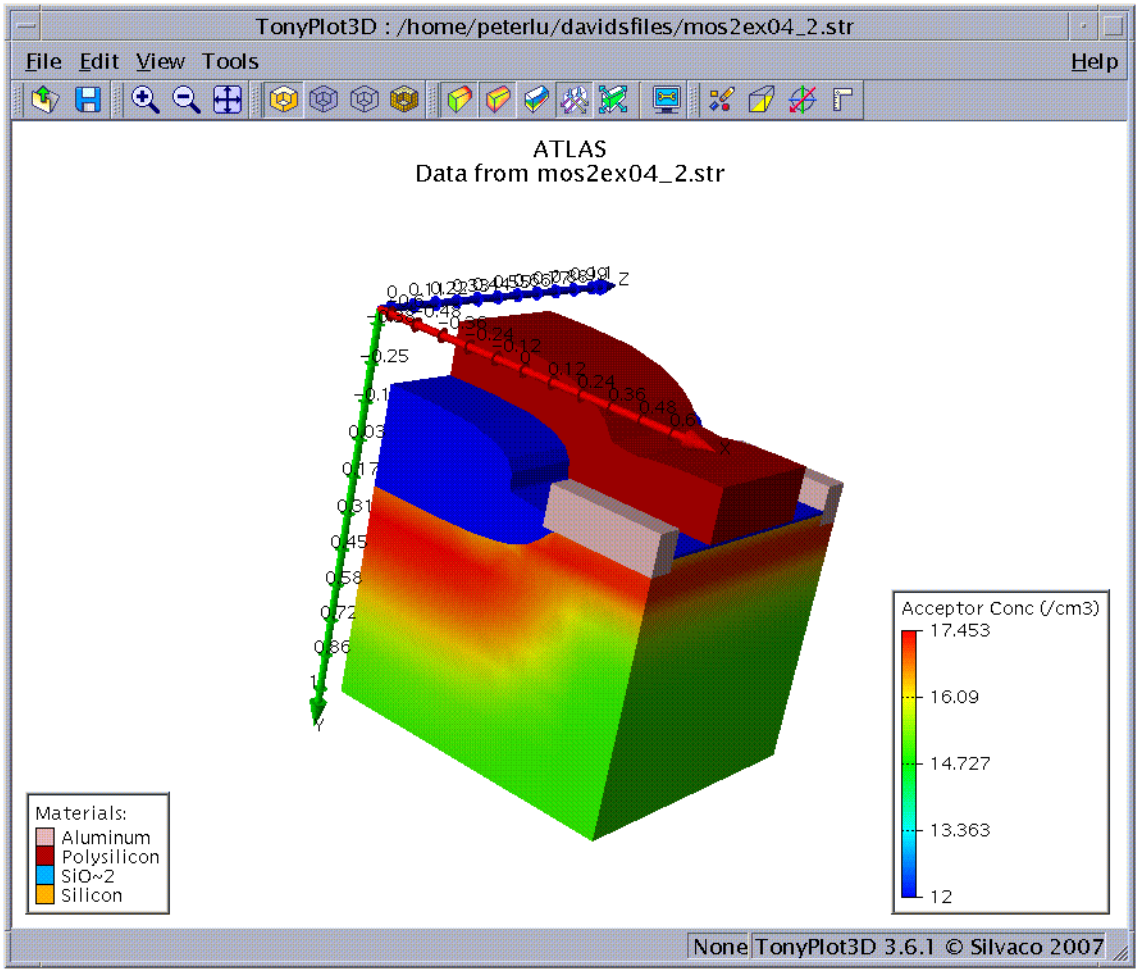


Figure 2-12: Contours in a plot

2.3.3: Rays

The Ray Display Mode (Figure 2-13) shows a list of all the rays contained in a structure file. When highlighted in the list and after pressing the **Apply** button, the rays are going are drawn in the Plot Area. The **Ray Settings** Group Box controls the way the rays are displayed. The rays can be displayed as lines or as cylinders. When drawn as lines, use the Line Width Pull-Down menu to change the thickness of the rays. When drawn as cylinders, use the Cylinder Radius Slider to change the relative size of the cylinder's radius. Use the CTRL key to select multiple rays in the list.

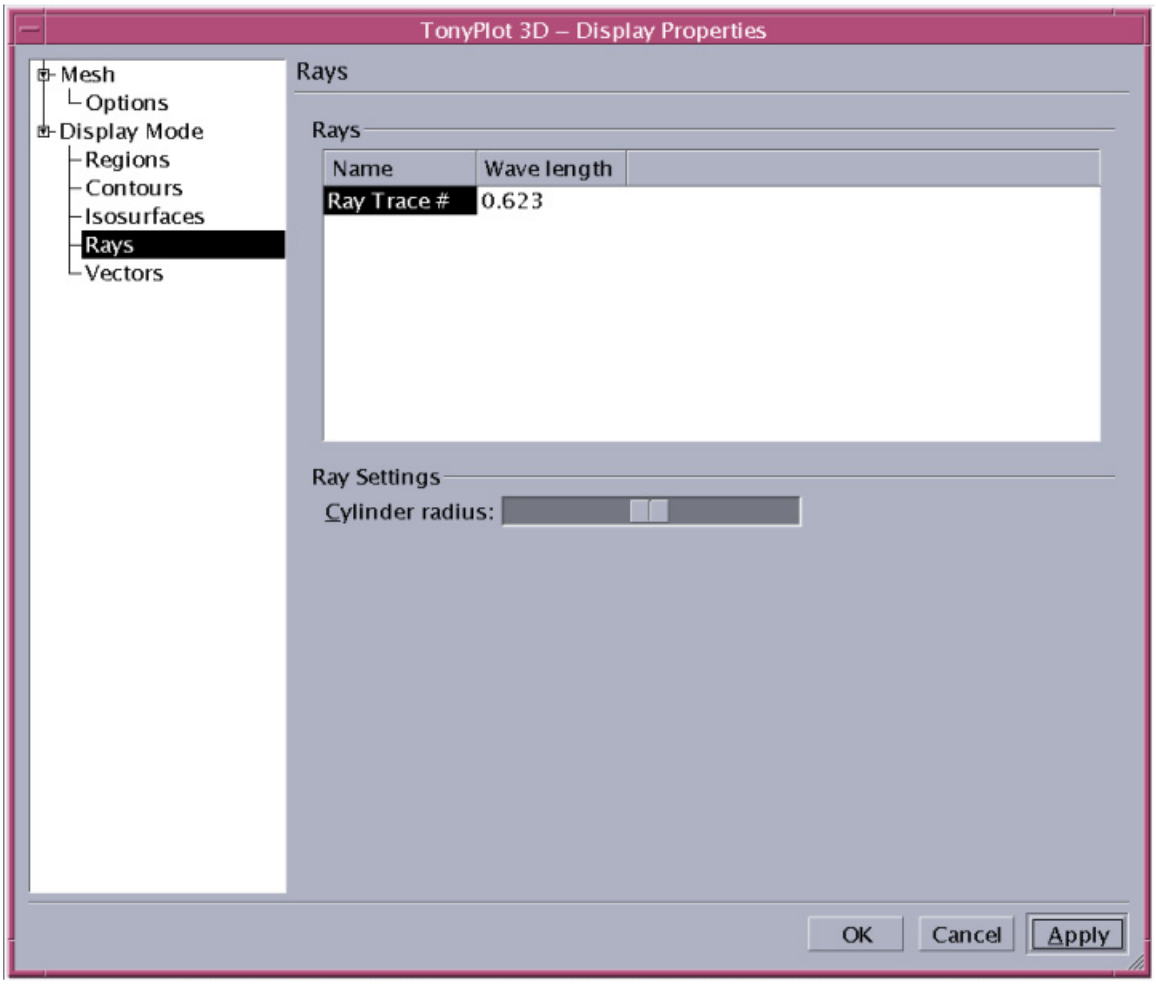


Figure 2-13: Ray Trace Display Mode

Figure 2-14 shows an example of rays displayed as lines.

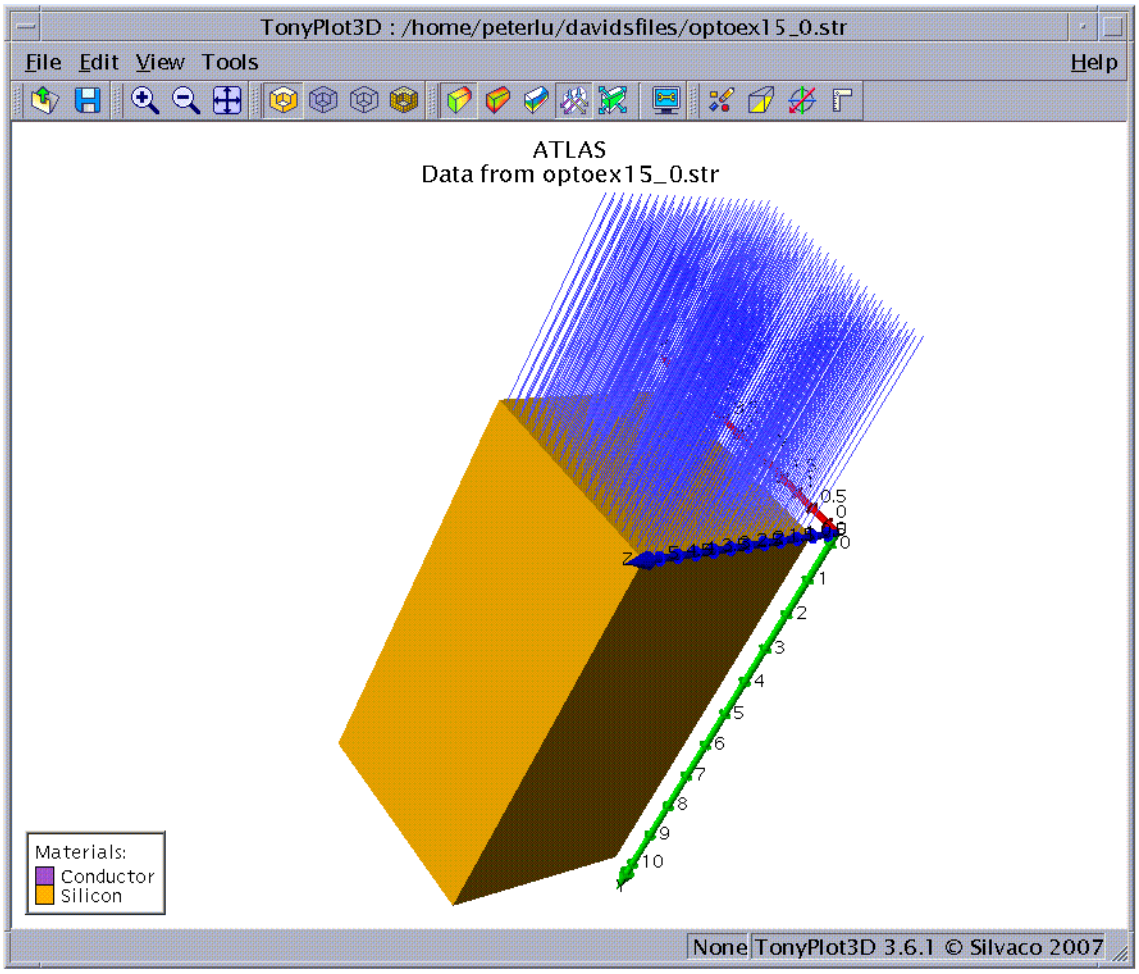


Figure 2-14: Example of rays in a plot

2.3.4: Isosurface

The Isosurface Display Mode is used to show surfaces of constant value throughout a 3D structure. The **Quantity** controls which impurity is used in the computation. The value of an isosurface has to be within the data range (**Min**,**Max**) of the **Quantity** and can be changed in the **Value** text field.

To view an isosurface, you can either turn on the **Preview IsoSurface** or select the **Create** button. Once created, the isosurface will appear in the isosurface list. Use the **Delete** button to remove the selected isosurface from the list. You can use the Draw Mode to change the appearance of all the isosurface at once (see Table 2-4).

Figure 2-15 shows a MOSFET that has been hit with SEU (Single Event Upset) alpha particle strikes. The path of the particle is shown by the isosurface plots of electron concentration.

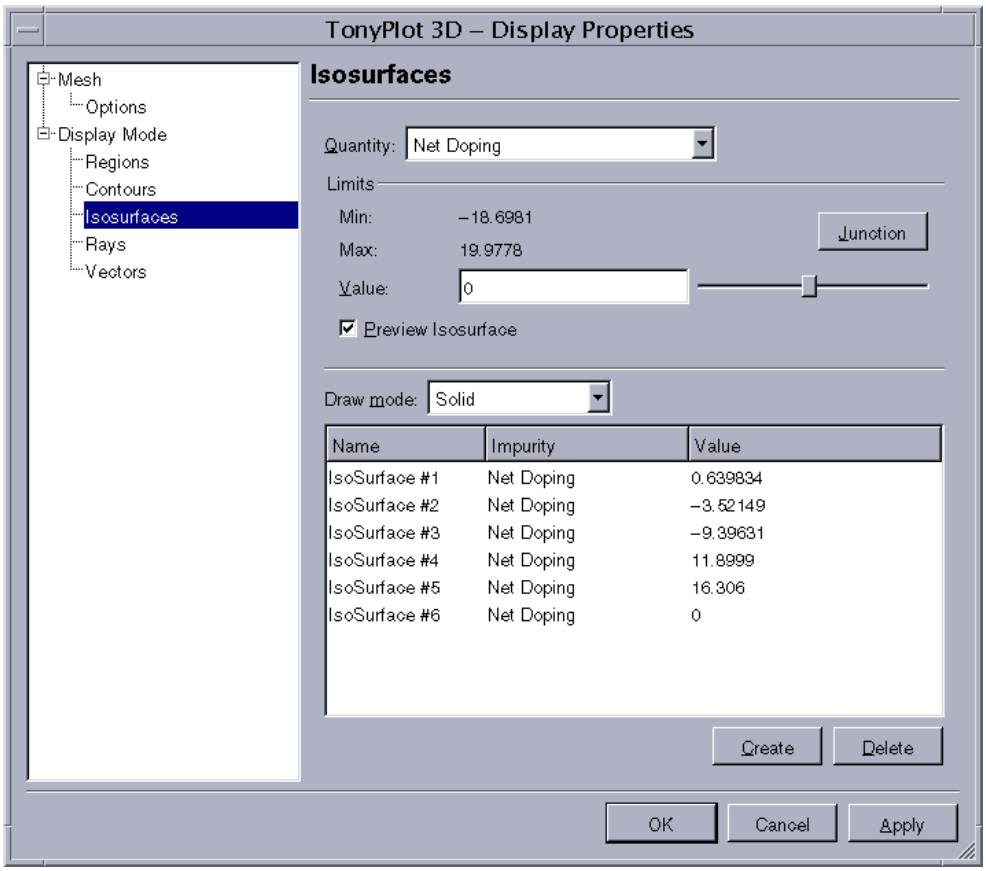


Figure 2-15: Isosurface Display Mode

To obtain the junction surface for net doping, click the **Junction** button in the Isosurface GUI. But first you need to set doping type to **n/p types**. To do that, select **Edit→Preferences** and the Applications Preferences Window will appear. Then, select **Dialogs/Plots Options** under **Settings**. In the dialog, choose **n/p types** under **Plot Options (Doping)**.

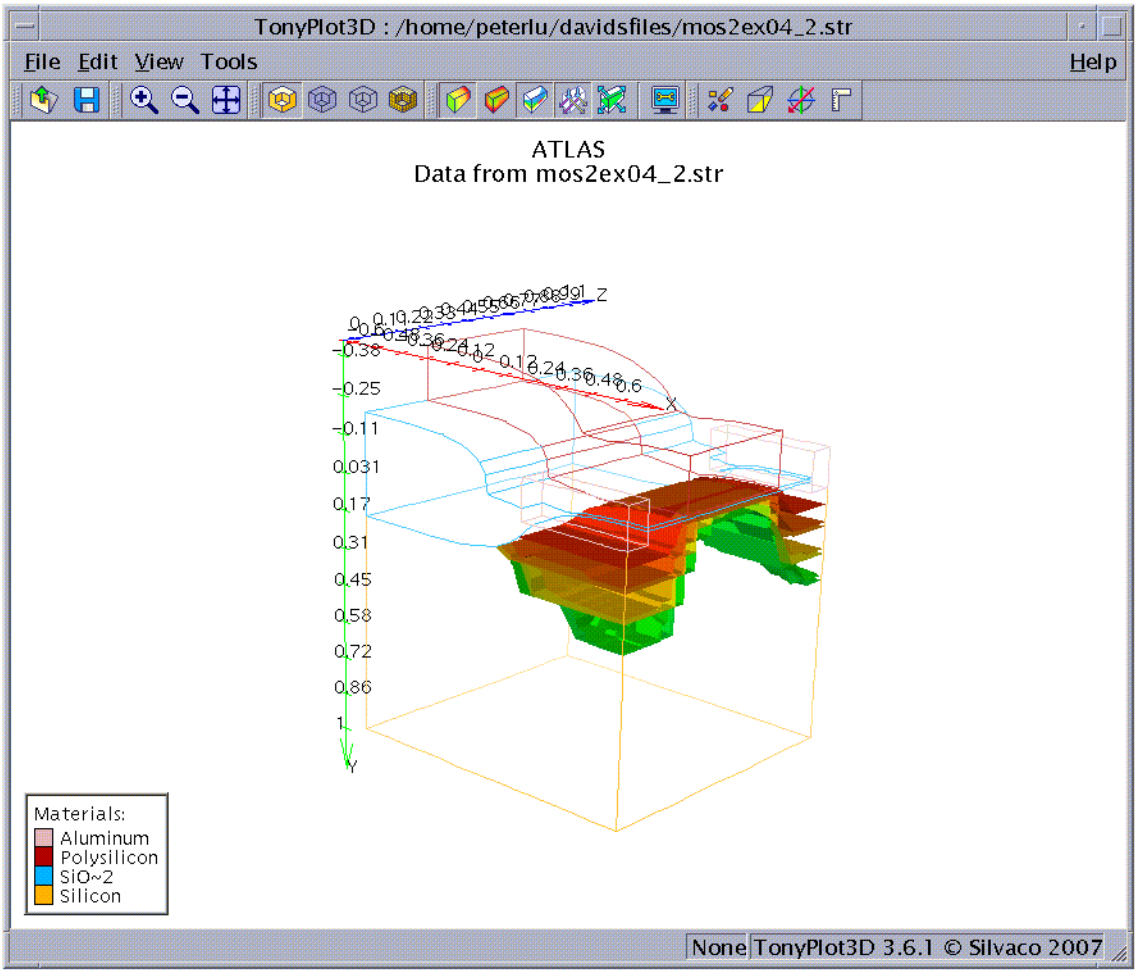


Figure 2-16: Example of Isosurfaces in a plot

2.3.5: Vectors

When a structure contains vector data, you can use this method to visualize their directions and magnitudes. Figure 2-17 shows the Vectors Display Mode.

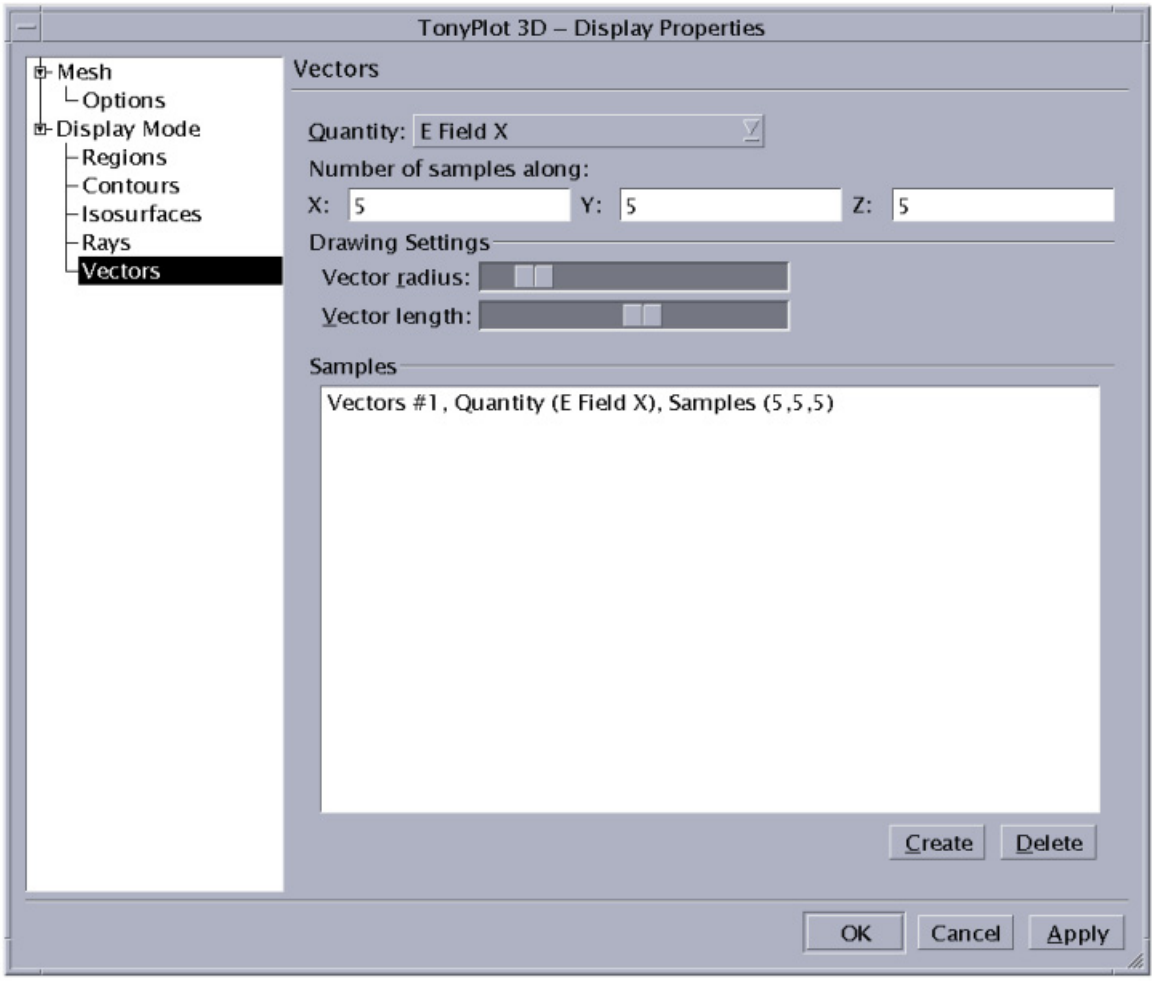


Figure 2-17: Vectors Display Mode

Use the **Quantity** menu to display a particular vector quantity. The number of samples along each axis can be altered with the respective box for x, y, and z.

Once you choose the particular vector to be displayed, it has to be created. To create it, click on the **Create** button. The dialog box describing the vector quantity will appear next to the **Create** button (see Figure 2-17). To have several vector quantities displayed simultaneously, create each vector separately.

You can control the way vectors are displayed by using the Draw Mode. In wireframe mode, a line is used to display the vectors. In Solid Mode, the vectors are drawn as cylinders and cones (solid arrows).

Linewidth changes the thickness of the vector lines. **Vector Length** and **Vector Radius** change the length and radius of the vectors respectively. The radius corresponds to the size of the arrow at the end of the vector.

Figure 2-18 shows an example of vectors in a plot.

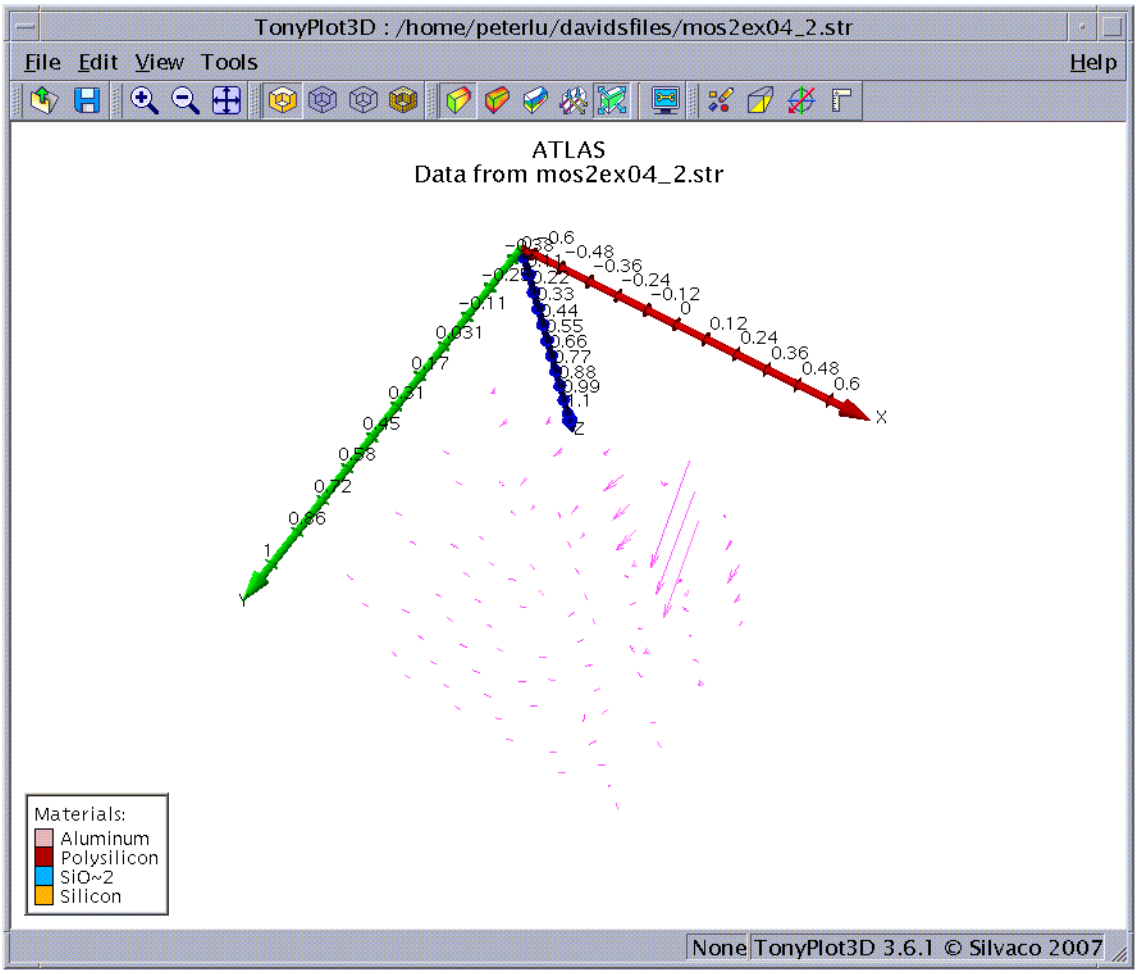


Figure 2-18: Example of Vectors in a plot

2.4: Tools

2.4.1: Object Browser

The Object Editor displays the objects in the current scene. The components of the structure follow a hierarchal tree formation (see Figure 2-19). Depending on what data is present in your structure and what is viewed, some of the objects listed below may not appear in the tree.

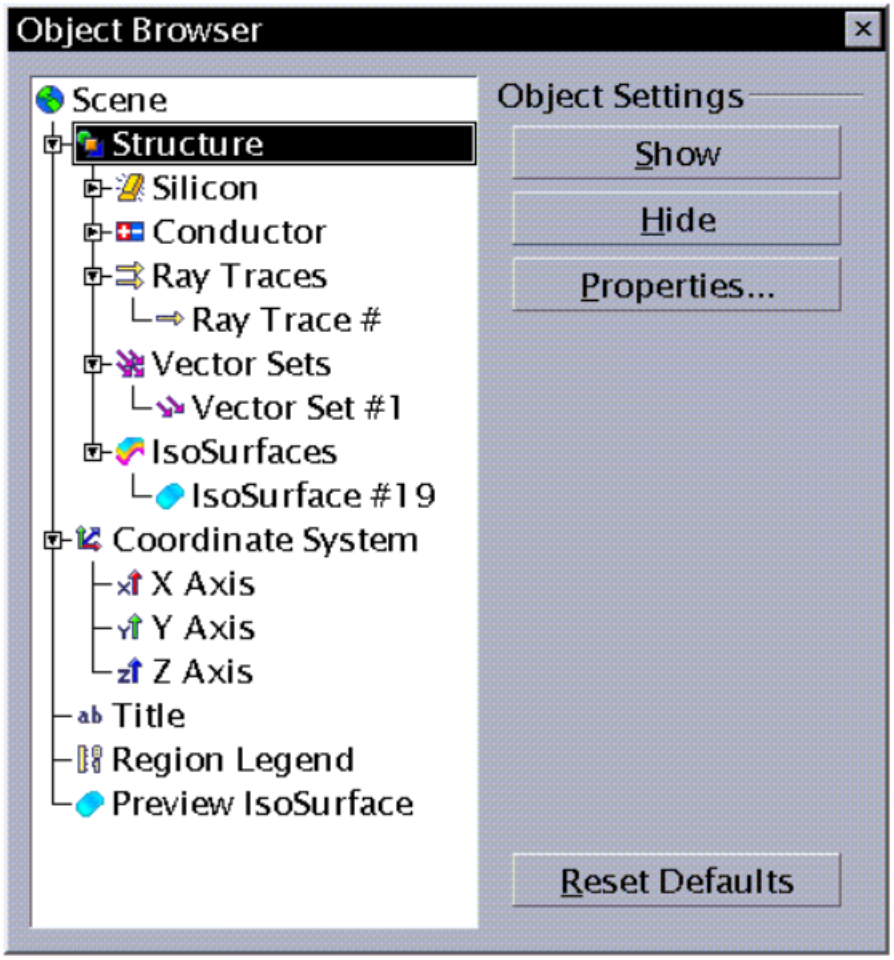


Figure 2-19: Object Editor

Table 2-6 lists and describes each part of the hierarchy.

Table 2-6: Object Hierarchy Structure

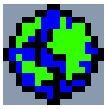
Icon	Type	Description
	Scene	This is the top level object within TONYPLOT3D's display. This is everything that appears in the Main Window. **Note:** Only one scene is currently supported.
	Structure	This is the main structure object. It is the parent object that contains all of the materials and regions. **Note:** Currently, only one structure per scene is supported
	Material	Each structure is broken up into a number of different materials (e.g., silicon, polysilicon, and so on).
	Region	Each material is then broken into a number of distinct regions. This is the lowest level object displayed in the object dialog.
	Electrode	Identifies the electrode settings.
	Ray Traces	Displays the ray trace settings.
	Ray Trace #	Displays the setting of an individual ray trace.
	Vector Sets	Displays the properties of the vector sets.
	Vector Set #	Displays the individual vector set.
	Isosurfaces	Displays the properties of the isosurfaces.
	Isosurface #	Displays the properties of the individual isosurface.

Table 2-6: Object Hierarchy Structure		
Icon	**Type**	**Description**
	Coordinate System	Identifies the coordinate systems axis.
	Title	Displays the Title properties for viewing and modifying.
	Legend	Displays the Legend properties for viewing and modifying. **Note:** Actually, there are two legends. One for the contours (Contours Legend) and the other for the regions (Region Legend).
	Probe	Displays the Probe properties
	Rulers	Displays the Ruler properties.
	Ruler #	Displays the properties of an individual ruler.

Table 2-7 shows the mouse actions that can be used in the object tree.

Table 2-7: Mouse Action Functionality	
Mouse Action	**Description of Functionality**
	The left mouse button is used on an icon to expand/shrink that branch of the tree. You can also use this button over an object name to select it, while deselecting all others.
	The middle mouse button is used to select/deselect an object name in the tree. Several objects can be selected at once by clicking on them. You can also use this button over an icon to expand/shrink that branch of the tree.
	The right mouse button is used on an object to display a menu, which allows you to change certain object settings. See Table 2-8 for a description of these menus.

Table 2-8: Right Mouse Menus			
Object	**Description**	**Menu Option**	**Description**
Scene	Applies to itself and all its children.	Show	Displays the entire scene.
		Hide	Omits the entire scene.
		Properties	Opens the Display View Mode (see Section 2.3: "Display Modes" section).
Structure	Applies to the structure and all its children. The right mouse menu options, however, are the same for the structure and its children (apart from ray traces, vector sets and iso-surfaces, these are detailed seperately). Therefore, the word "structure" is inter-changeable with "children".	Show	Displays the entire structure.
		Hide	Hides the structure.
		Opaque	Causes the structure to be opaque.
		Transparent	Causes the structure to be transparent.
		Solid	Causes the structure to be solid.
		Meshed	Displays the mesh for the structure.
		Edges	Displays only the edges of the structure.
		Solid and Meshed	Causes the structure to appear solid and meshed.
		Properties	Opens the Object Properties Pop-up, where you can modify all the above menu options.
Structure: Ray Traces	Displays the rays' properties.	Show	Displays the rays.
		Hide	Hides the rays.
		Properties	Allows you to show or hide the rays. You can also change the draw mode (**line** or **cylin-der**) and the linewidth.

Table 2-8: Right Mouse Menus			
Structure: Ray Trace #	Displays an individual ray's properties.	Show	Displays the ray.
		Hide	Hides the ray.
		Properties	Allows you to show, hide, or change the color of a ray.
Structure: Vector Sets	Displays the vector sets' properties.	Show	Shows the vector sets.
		Hide	Hides the vector sets.
		Properties	Allows you to to show or hide the vector sets. It also allows you to change the draw mode (**wireframe** or **solid**) and linewidth.
Structure: Vector Set#	Displays a vector set's properties.	Show	Shows the vector set.
		Hide	Hides the vector set.
		Properties	Allows you to show, hide, or change the color of a vector.
Structure: Isosurfaces	Displays isosurfaces' properties.	Show	Shows the isosurfaces.
		Hide	Hides the isosurfaces.
		Properties	Allows you to show or hide the isosurface.
Structure: Isosurface#	Displays an individual isosurface's properties.	Show	Shows the isosurface.
		Hide	Hides the isosurface.
		Properties	Allows you to show, hide, or change the color of an isosurface.
Coordinate System	Identifies the coordinate systems axes. The axes (X,Y, and Z) also have their own menus. These menus perform similar functions, except the functions pertain to the individual axis rather than the entire axes of the system.	Show	Shows the axes.
		Hide	Hides the axes.
		Properties	Allows you to show or hide the axes and change the numerical precison of them. For the individual axis (X,Y or Z), you can show, hide, and change the color of the axis and its label. You can also show, hide, and change the number of tick (increment) marks in the axis.

Table 2-8: Right Mouse Menus			
Title	Displays the Titles' properties.	Show	Shows the Title.
		Hide	Hides the Title.
		Properties	Allows you to show, hide, move, and change the color of the title. You can also move the title by hovering the mouse pointer over the title and pressing Shift. Use the left mouse button and drag it to the desired location. Also in this menu, you can change the name of the title and the subtitle. The position of the title can either be constrained or floating. If it's constrained, it remains at its position when you resize the screen. If it's floating, the position changes with the size of the screen.
Legend	Displays the Legend's (Contours and Region) properties.	Show	Shows the Legend.
		Hide	Hides the Legend.
		Properties	Allows you to show, hide, move, and change the color of the legend. You can move the legend in the same way as the Title, which is described above. The position of the Legend can either be constrained or floating, which does the same thing as for the Title.
Probe	Displays the Probe's settings.	Show	Shows the Probe.
		Hide	Hides the Probe.
		Properties	Allows you to show or hide the Probe. You can also change the color of the probe and its axes.
Ruler	Displays the Rulers' settings.	Show	Shows the rulers.
		Hide	Hides the rulers.
		Properties	Allows you to show, hide, and change the precision of the rulers.

Table 2-8: Right Mouse Menus			
Ruler#	Displays the settings of an individual ruler.	Show	Shows an individual ruler.
		Hide	Hides an individual ruler.
		Properties	Allows you to show, hide, and change the color of an individual ruler. You can also show, hide, and change the color of the individual ticks (increment marks) and their labels.

2.4.2: Cutplane

The cutplane is a plane (2D slice) that's drawn through a 3D structure. The cutplane may be used so you can examine the inside of a structure or to perform 2D device within ATLAS. An example of a cutplane is shown in Figure 2-20. For more information about ATLAS, see the ATLAS USER'S MANUAL.

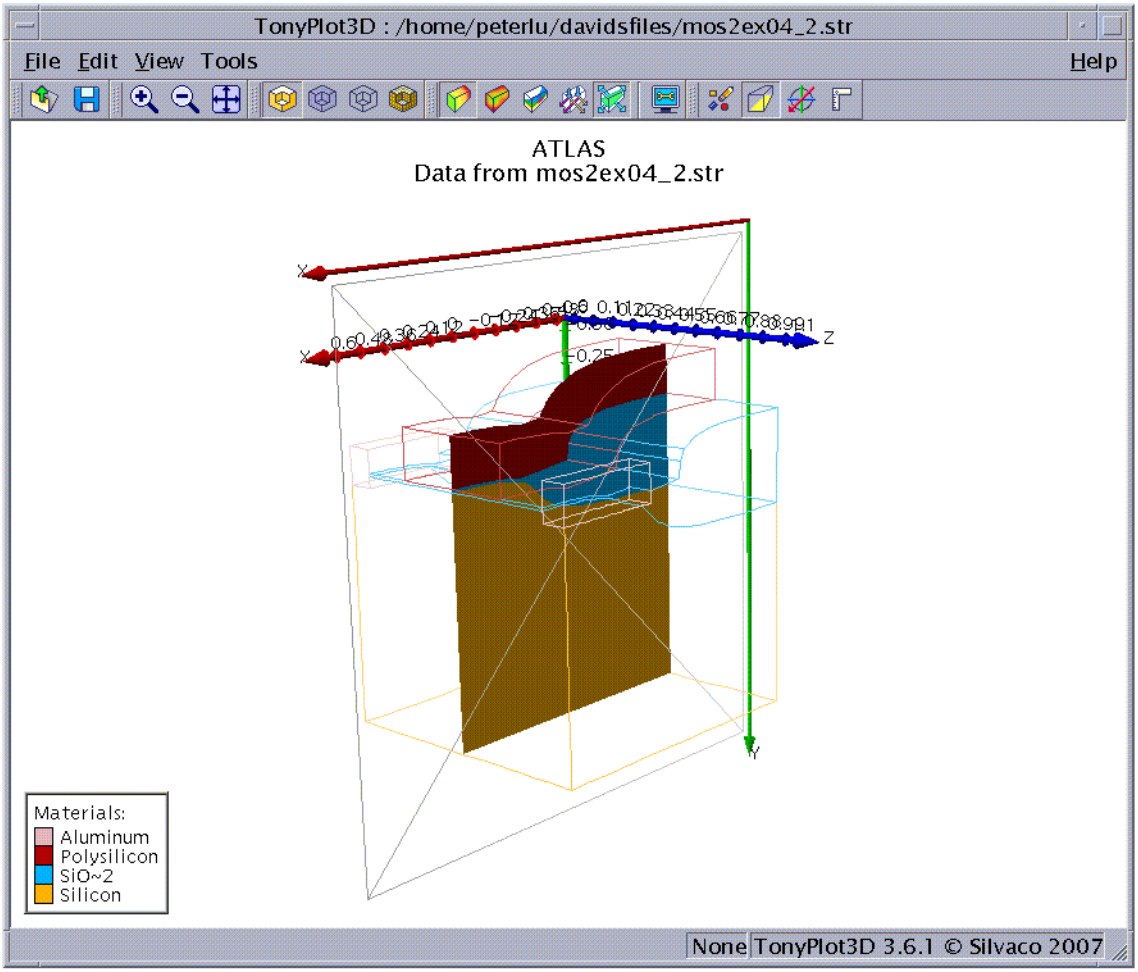


Figure 2-20: An example of a cutplane

Figure 2-21 shows the Cutplane Dialog. The top half of this figure shows the various settings to adjust the cutplane, while the bottom half shows the extracted cutplane.

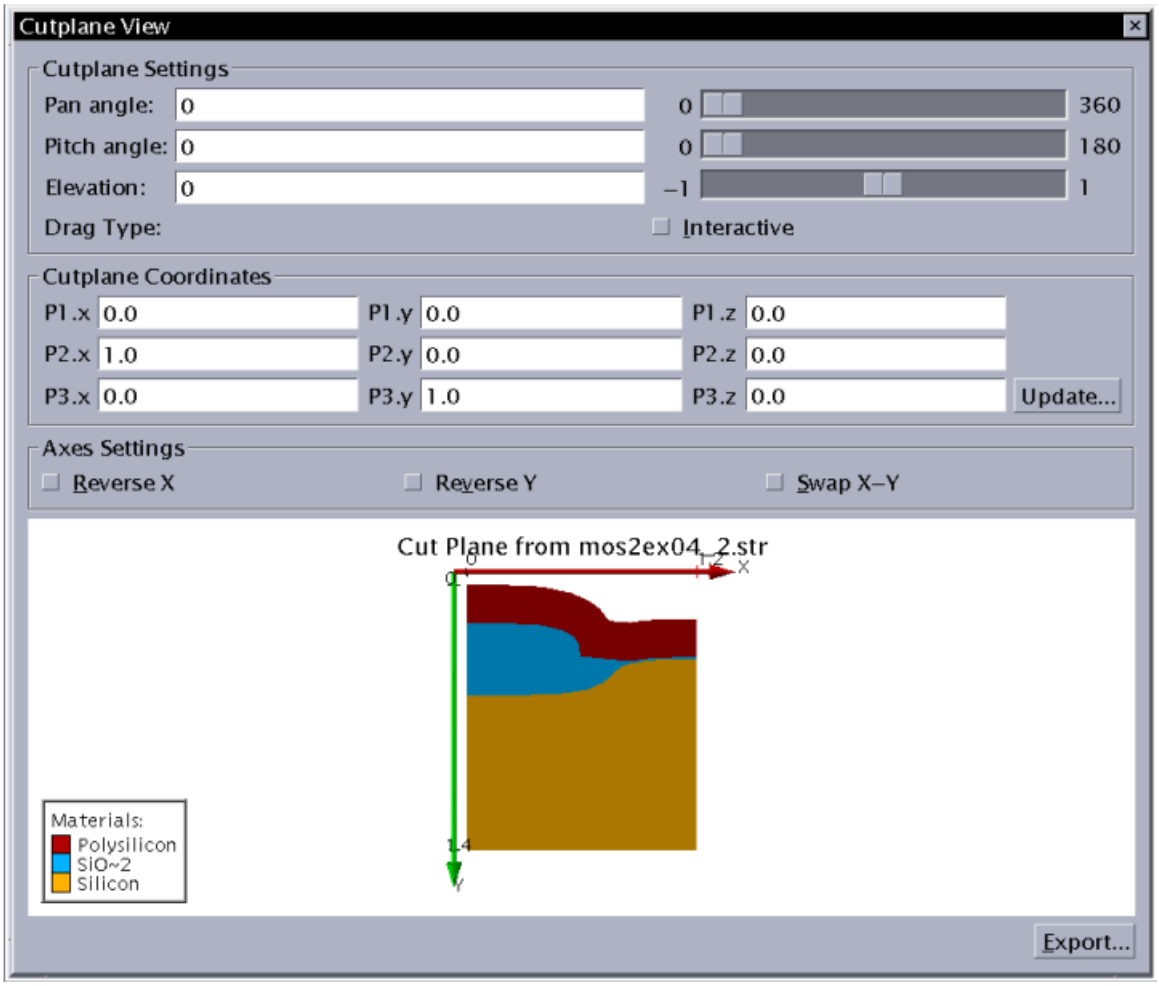


Figure 2-21: Cutplane Dialog

In the **Cutplane Settings** area, the exact position of the cutplane is chosen through three cutplane settings. The first two settings position the angle of the plane relative to the axis. The third setting sets the spatial position relative to the normal on the cutplane.

The cutplane can be defined by specifying three points. This provides a quantitative way to specify the position of a cutplane. In the **Cutplane Coordinates** area, input three points coordinates and click **Update...** (see Figure 2-22). The cutplane will be shown through those points. Meanwhile, the content in the **Cutplane Settings** area will be updated accordingly.

If all three points are collinear, a warning message dialog will appear (Figure 2-24) to remind you to input the correct coordinates.

Once you define the cutplane, you can adjust its position by either changing the values or moving the sliders in the **Cutplane Settings** area. Figure 2-22 shows a cutplane defiend with points (0.0, 0.0, 0.5), (0.5, 0.0, 0.5), and (0.0, 0.5, 0.5). The **Elevation** value is changed from –0.09 in Figure 2-22 to 0.59 in Figure 2-23, which reflects the new position of cutplane.

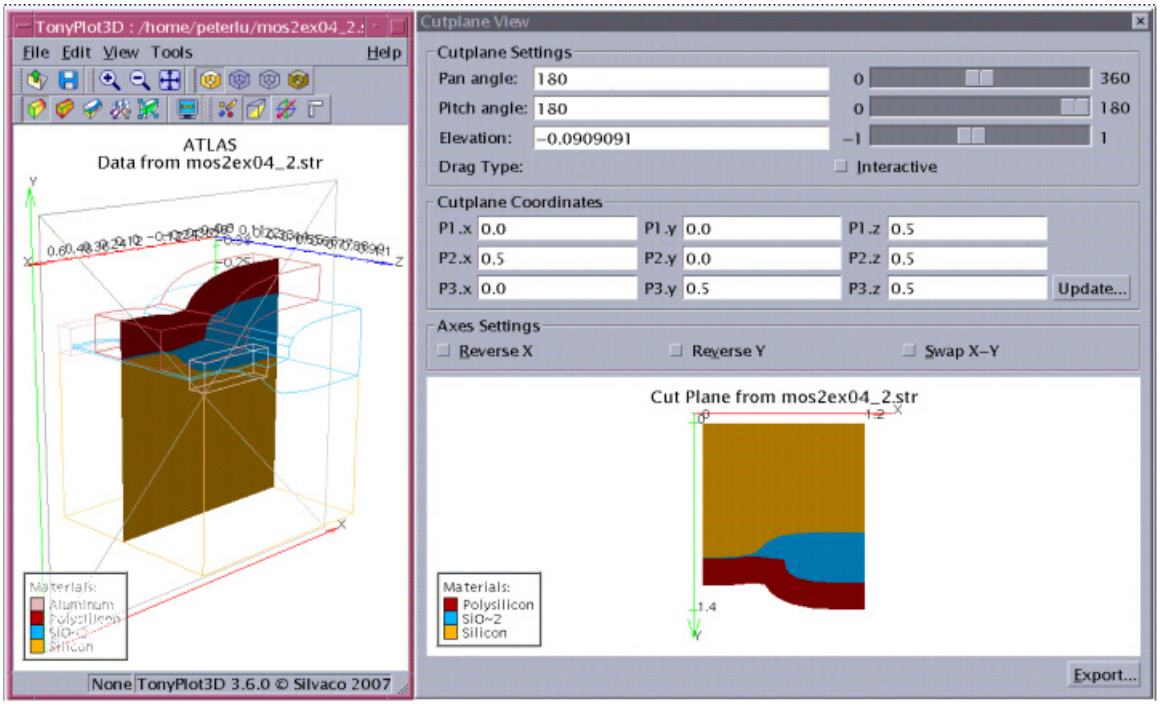


Figure 2-22: Defining a cutplane with three points

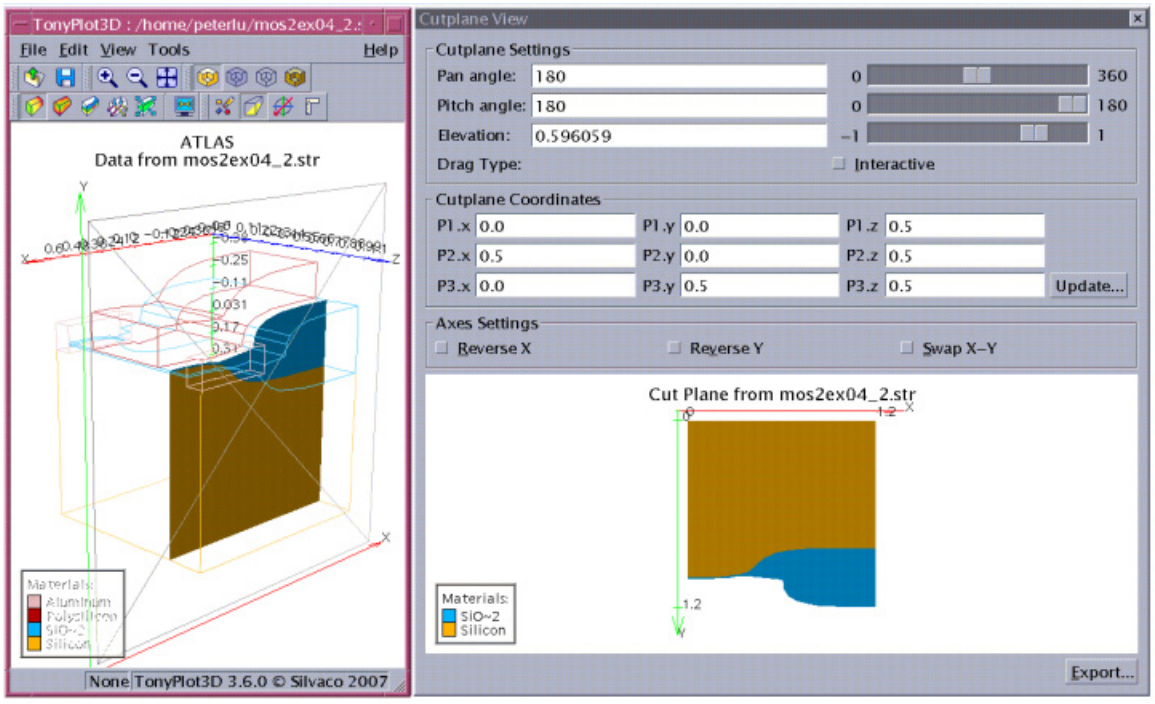


Figure 2-23: New cutplane position with new Elevation value (compared to Figure 2-22)

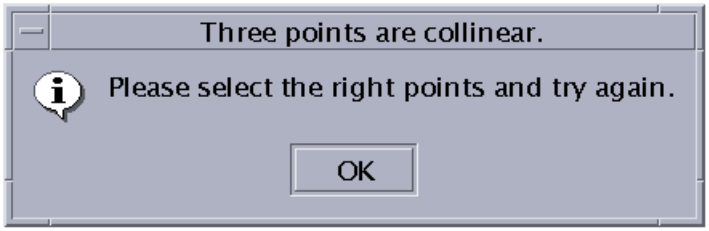


Figure 2-24: Three Points are collinear warning message

The cutplane itself can be drawn solid to visually aid its positioning. You can also alter the color of the cutplane.

While positioning the cutplane, you can monitor the positioning continuously as it changes or update it after it has been moved. To do this, toggle the **Drag Type** switch (i.e., **Interactive** or not respectively).

You can also alter the display of the cutplane by using any of the draw modes previously described in Table 2-4.

Axes Settings allows you to reverse the x axis, the y axis, or swap them over.

Cutplane Settings File

The cutplane settings file contains the settings and coordinates of the cutplane. This file is created after saving a cutplane. To do this, select **File→Save Set File**.

If you want to see a previously saved cutplane, then you need to load the cutplane settings file. There are two ways to load the cutplane settings file. The first way is by using the command line. To do this, type `tonyplot3d -V 3.8.3.R structure.str -set cutplane.set`. The second way is by using the GUI. To do this, select **File→Load Set File** to select a file. Then, press  .

You can also change the cutplane by changing the information in the cutplane settings file. There are two ways to change the file. The first way is change it in a text editor. The following shows the information you would need to change.

```
#begin of file
#Cut Plane Set File
#Put any comment after #

#Pan, Pitch and Elevation definition

PAN 180
PITCH 132
ELEV -0.5

#Three points which define the cut plane

point_1 0.0 0.0 0.0
point_2 1.0 0.0 0.0
point_3 0.0 1.0 0.0


EOF

#end of file
```

The second way is to change the file in the GUI. To do this, load the cutplane settings file, change the settings in the Cutplane Dialog, and select **File→Save Set File** to a specific file name. When a cutplane settings file is loaded, the initial cutplane position is defined with **PAN**, **PITCH**, and **ELEV**. If you want to use the three points to define the cut plane, then click the **Update** button.

Once you've obtained the desired plane, you can export it directly to a file or TONYPLOT by using the Export Slice Dialog. Press the **Export** button to open the Export Slice Dialog (Figure 2-25). If it's going to be exported to a file, enter the file name in the appropriate box.

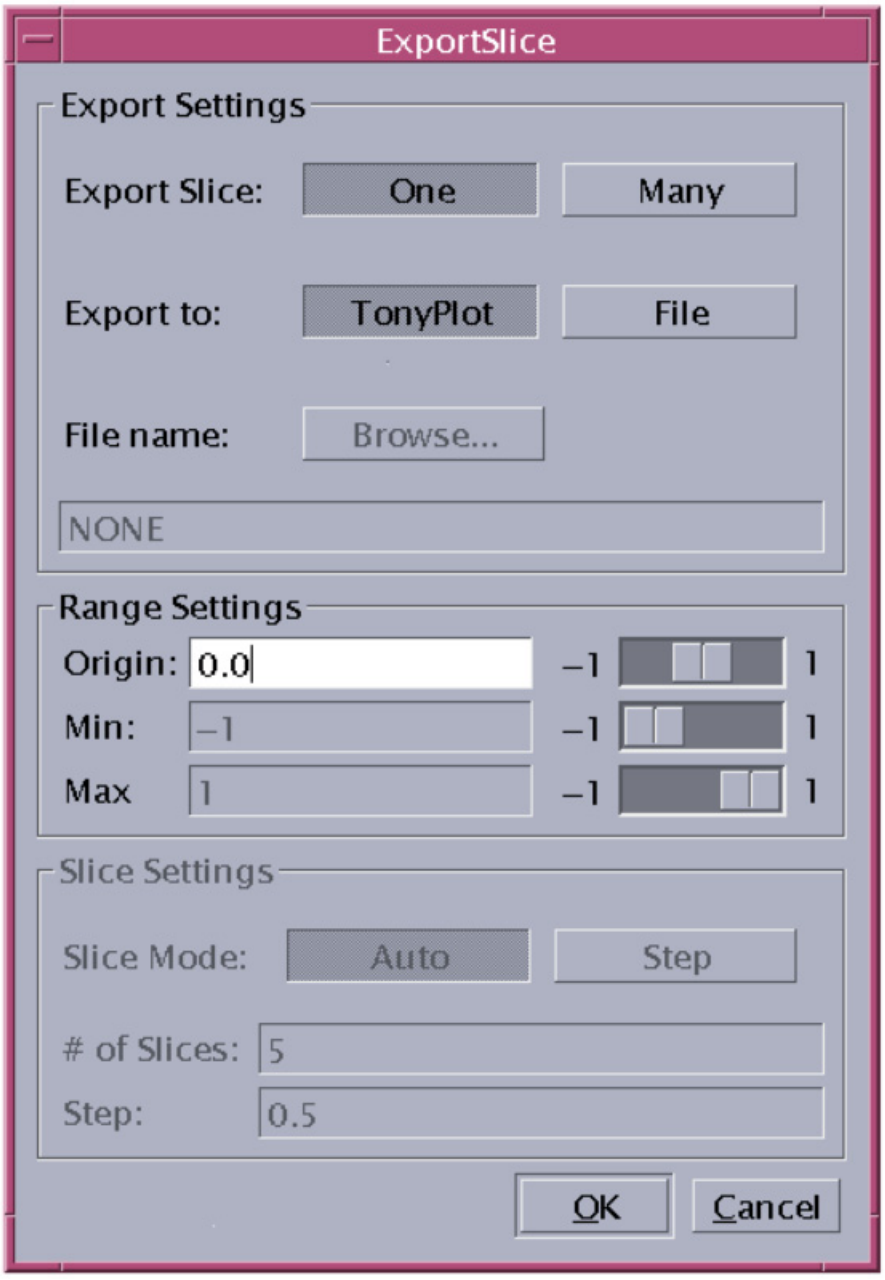


Figure 2-25: Export Slice Dialog

One or several planes can be exported at once, depending on the **Export Slice** switch. To export several planes, adjust the **Min** and **Max** settings. These settings correspond to the start and end of the spatial position of the cutplanes.

The **Slice Settings** can be set to **Auto** or **Step**. If it's set to **Auto**, you need to choose the number of steps. If it's set to **Step**, then you need to define the step size.

When TONYPLOT3D exports a cutplane to TONYPLOT, the temporary file name now has an unique, informatic form "structurename_slice_sequencenumber.str". Here, the "structurename" is name of the original 3D structure with the .str suffix removed, and "sequencenumber" is an integer. To export the cutplane to TONYPLOT, press **Export** in the Cutplane View window. During the exporting, TONYPLOT3D checks the temporary directory and searches for all occurrences. The unique sequence number is selected starting from 1 until the first available integer. If, for example, there are 6 files (all have the same structurename) with the sequence number from 1 to 6 existing in the temporary director, then the next highest integer (7) will be chosen. In Figure 2-26, the structurename is mos2ex04_2, the sequencenumber is 7.

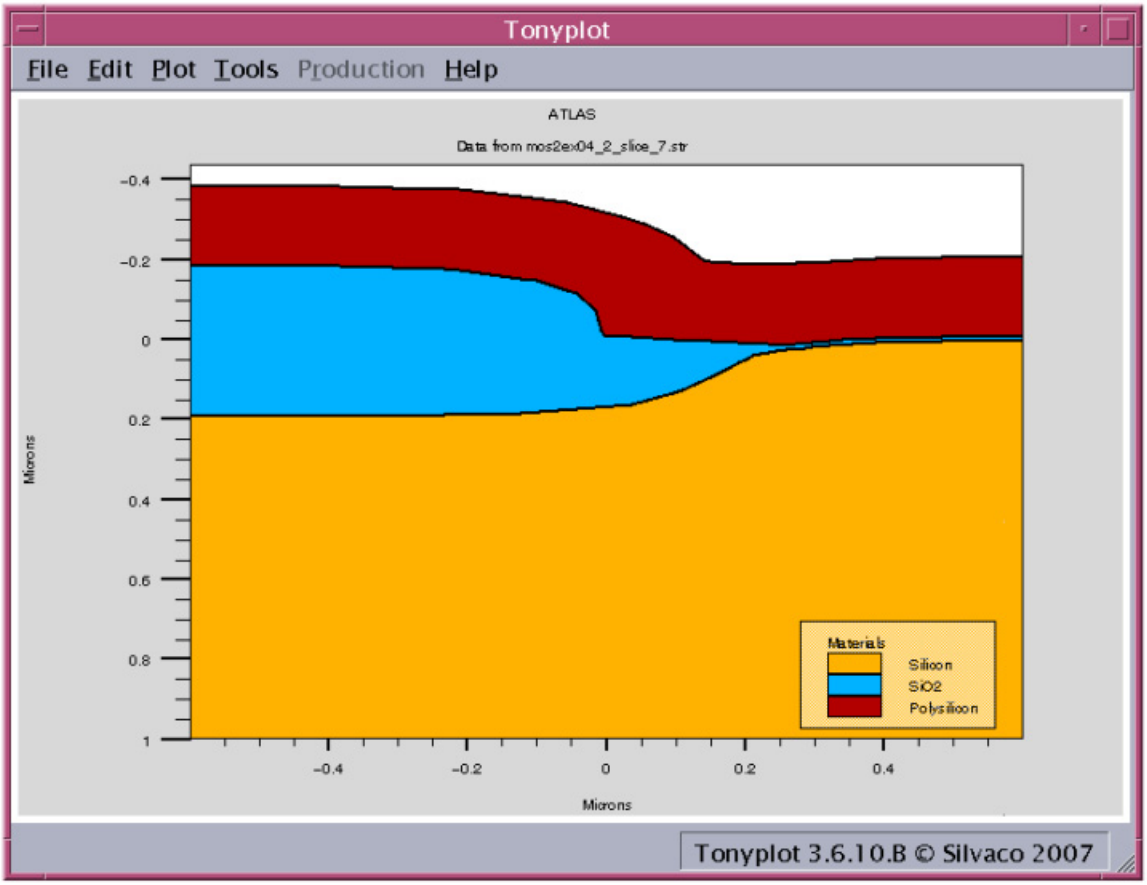


Figure 2-26: Unique Cutplane Name Form

2.4.3: Probe

The Probe Tool allows you to probe any point within the structure. To probe a point, click the **Probe** button in the Toolbar.

A particular point in the structure needs to be selected for the probe to extract data for all the quantities present in the structure. When you click on the structure, a sphere appears at the selected location on the structure (see Figure 2-27). The Probe View is then updated with the relevant information (see Figure 2-28).

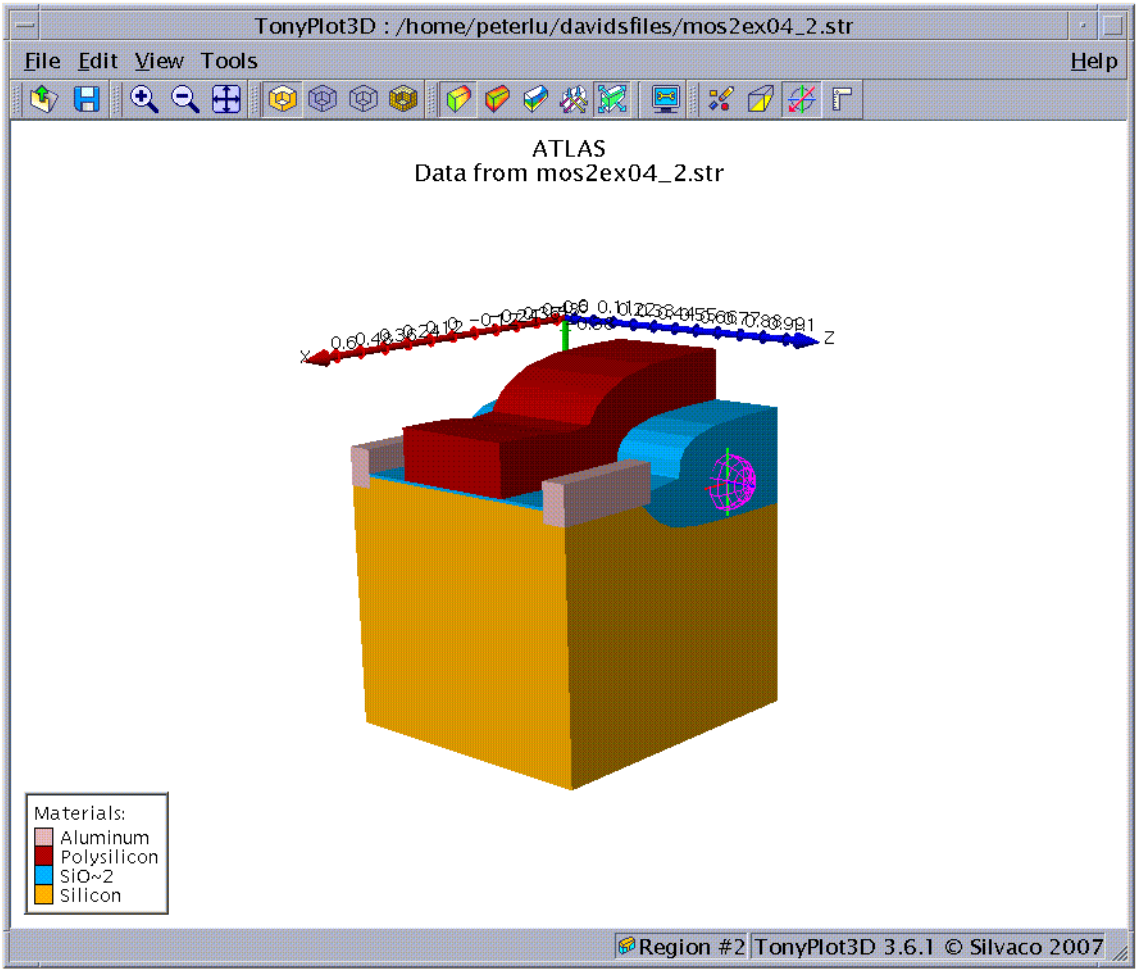
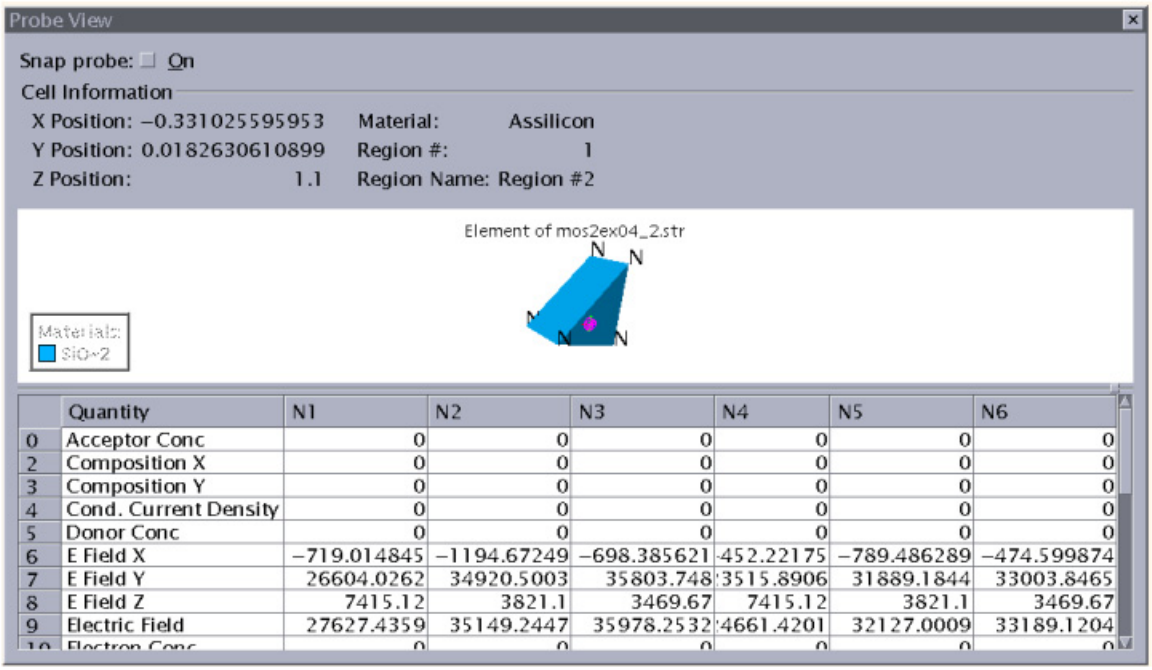


Figure 2-27: An example of a Probed Structure



	Quantity	N1	N2	N3	N4	N5	N6
0	Acceptor Conc	0	0	0	0	0	0
2	Composition X	0	0	0	0	0	0
3	Composition Y	0	0	0	0	0	0
4	Cond. Current Density	0	0	0	0	0	0
5	Donor Conc	0	0	0	0	0	0
6	E Field X	−719.014845	−1194.67249	−698.385621	452.22175	−789.486289	−474.599874
7	E Field Y	26604.0262	34920.5003	35803.748	3515.8906	31889.1844	33003.8465
8	E Field Z	7415.12	3821.1	3469.67	7415.12	3821.1	3469.67
9	Electric Field	27627.4359	35149.2447	35978.2532	4661.4201	32127.0009	33189.1204
10	Electron Conc	0	0	0	0	0	0

Figure 2-28: Probe View

The sphere and the picked element (prism or tetrahedron) will be drawn with identifiers at its nodes in the Probe View. For each node, quantity values are displayed. The exact position of the probe is also shown with its material and region identification (x, y, and z positions).

You can also use the mouse to move the picked element in the Probe View as described in the "Plot Control Using the Mouse" section on page 2-6.

Note: You can also probe the triangles of the cutplane. The picked triangle is then drawn in the Probe View. The element/face is positioned with the same orientation in the Probe View as it appears in the Main Window.

2.4.4: Ruler

The Ruler Dialog (Figure 2-29) is used to obtain information about quantities within the structure. To use the ruler, hold down the Control key and the left mouse button where you wish to start. Then, drag the mouse and release the button where you wish to stop.

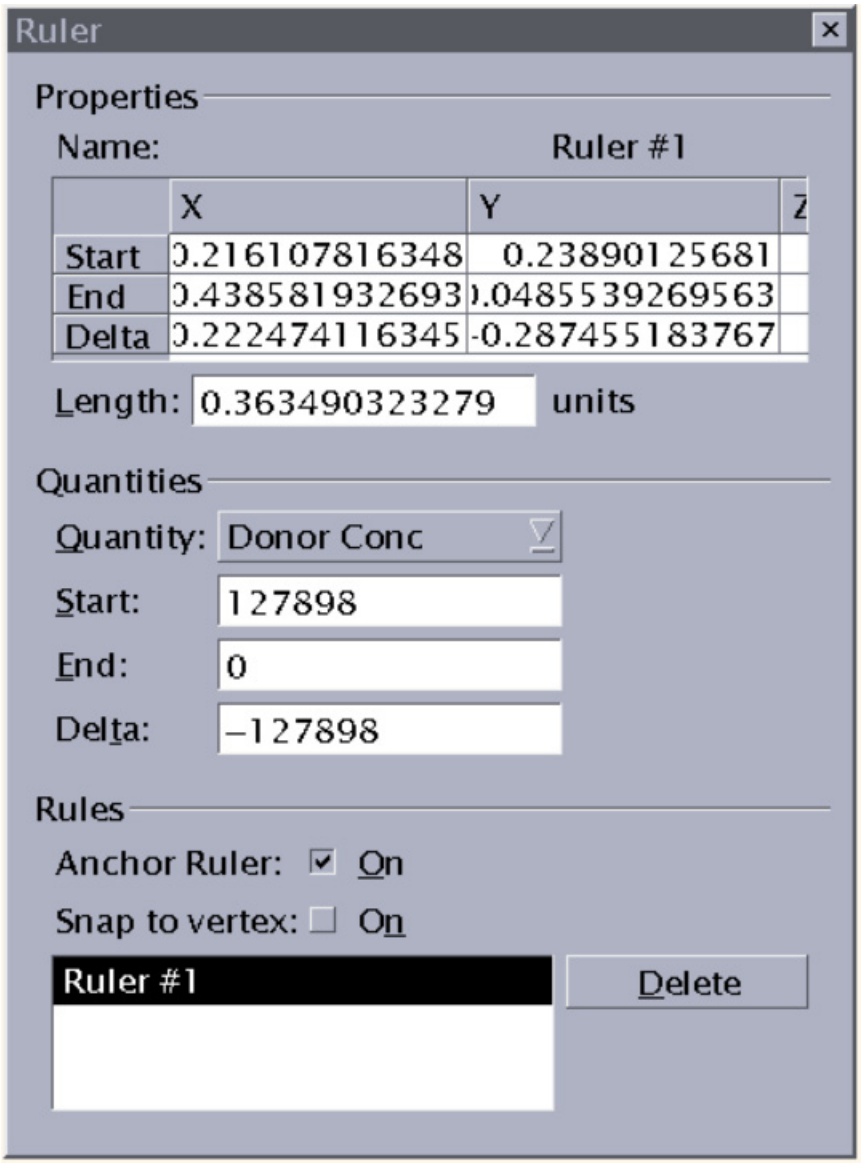


Figure 2-29: Ruler Dialog

The **Start** XYZ and **End** XYZ positions with the difference between each respective pair, **Delta**, is shown in the top of the dialog (see Figure 2-29). The length of the line, **Length**, is also shown.

Any quantity value present in the structure can also be displayed for the **Start** and **End** points along with their difference in the Ruler Dialog.

To choose a quantity, select it from the **Quantity** menu. You can also make the ruler permanent by toggling the **Anchor Ruler ON/OFF** switch. To anchor a ruler, check the **Anchor Ruler** box before you draw the ruler.

Figure 2-30 shows the ruler drawn from the data in Figure 2-29.

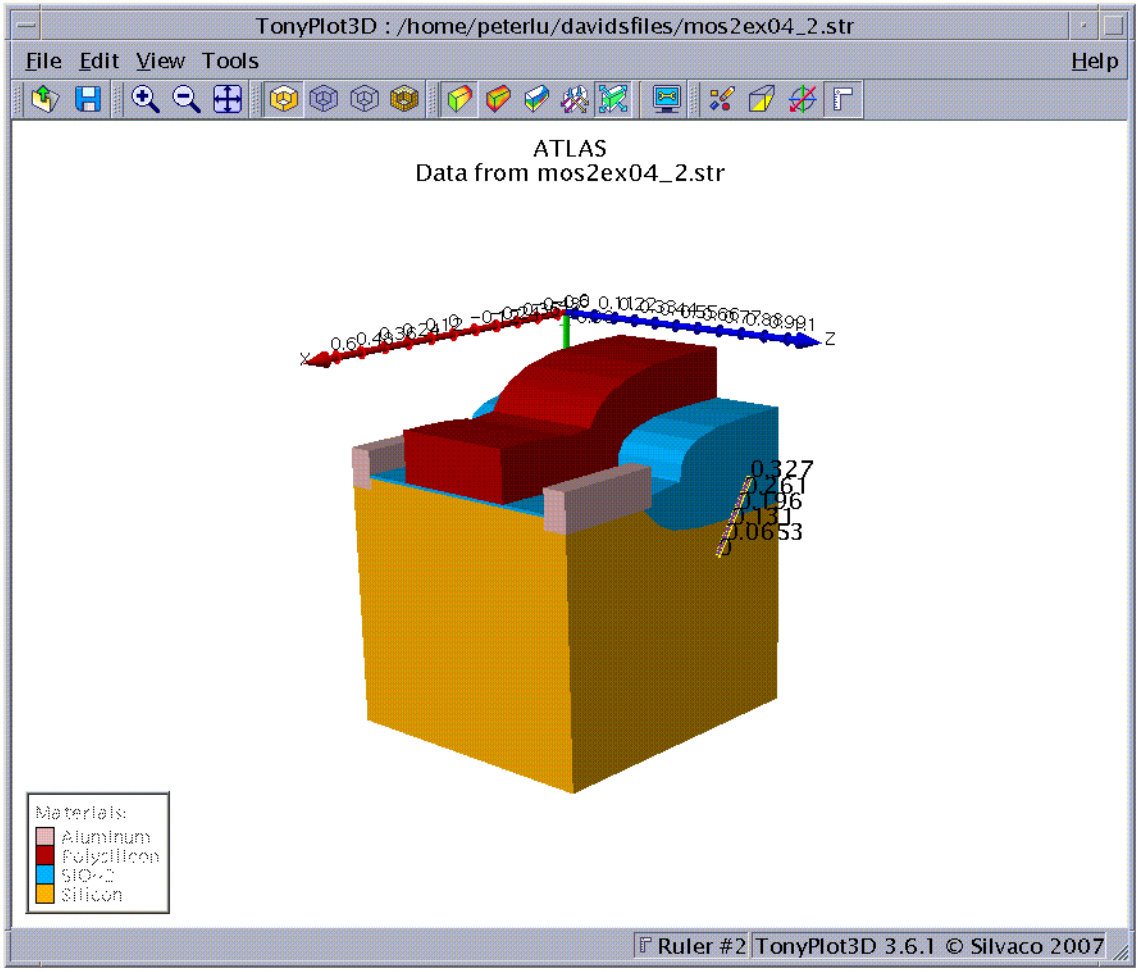


Figure 2-30: An example of a drawn ruler

A ruler indentfier will be created. You can anchor several rulers in a structure, each of which has an identifier. You can delete each ruler separately or all at once.

You can snap the ruler to existing vertices in the structure by using the **Snap Ruler** switch. The closer vertex on the selected face is chosen instead of an interpolation of a position in the face (with the interpolation of the quantities as well).

2.5: Preferences

2.5.1: Colors

This tab (Figure 2-31) can be used to adjust the colors of the various components of a structure.

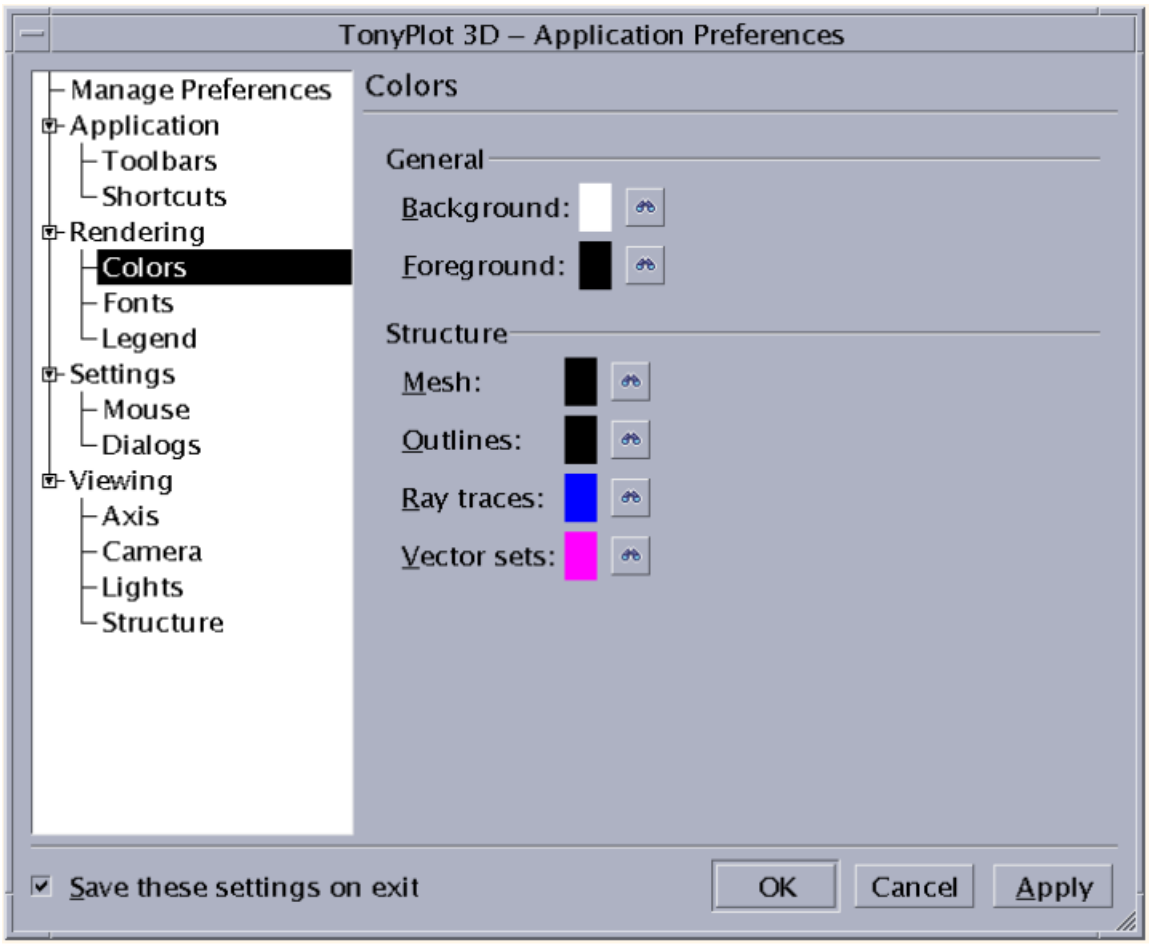


Figure 2-31: Colors Tab

2.5.2: Fonts

This tab (Figure 2-32) can be used to change the fonts used in plots.

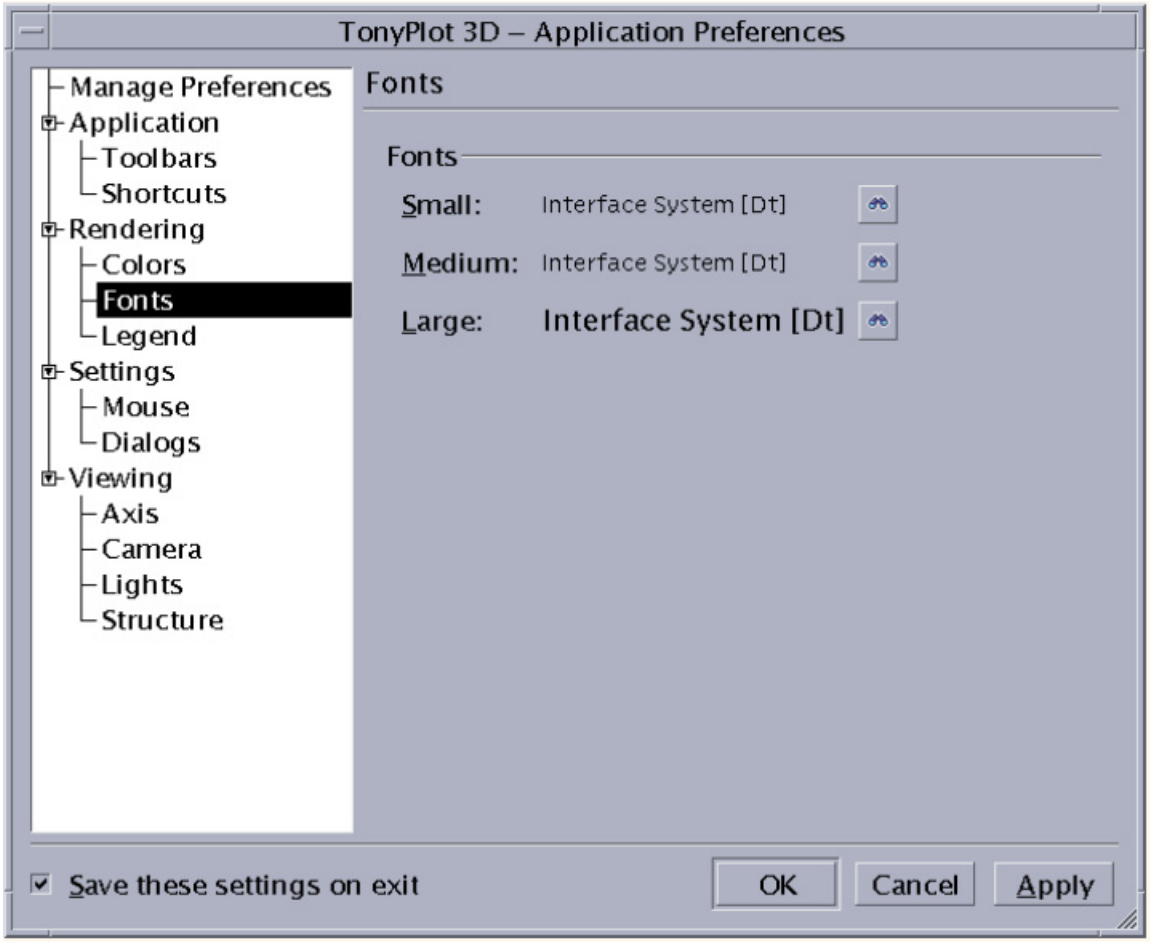


Figure 2-32: Fonts Tab

2.5.3: Legend

This tab (Figure 2-33) can be used to adjust the settings of the legends (Contours and Regions).

Note: The **Height** adjustment only pertains to the Contours Legend.

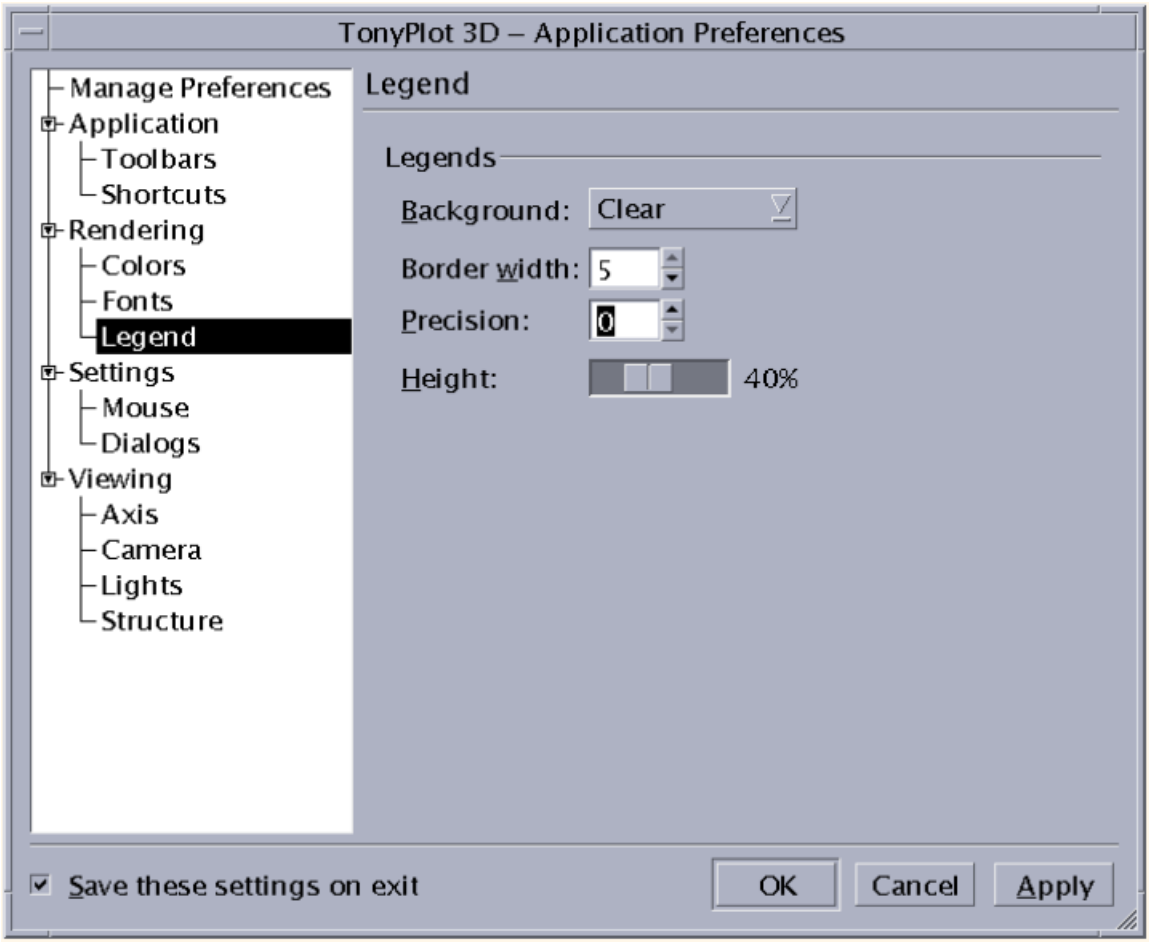


Figure 2-33: Legend Tab

2.5.4: Mouse

This tab (Figure 2-34) can be used to adjust the mouse buttons settings. See Section 2.1.3: "Plot Control Using the Mouse" for a description of these functions. **Automatic Movements** controls whether the structure will move automatically or not when you release one of the mouse buttons while still dragging the mouse.

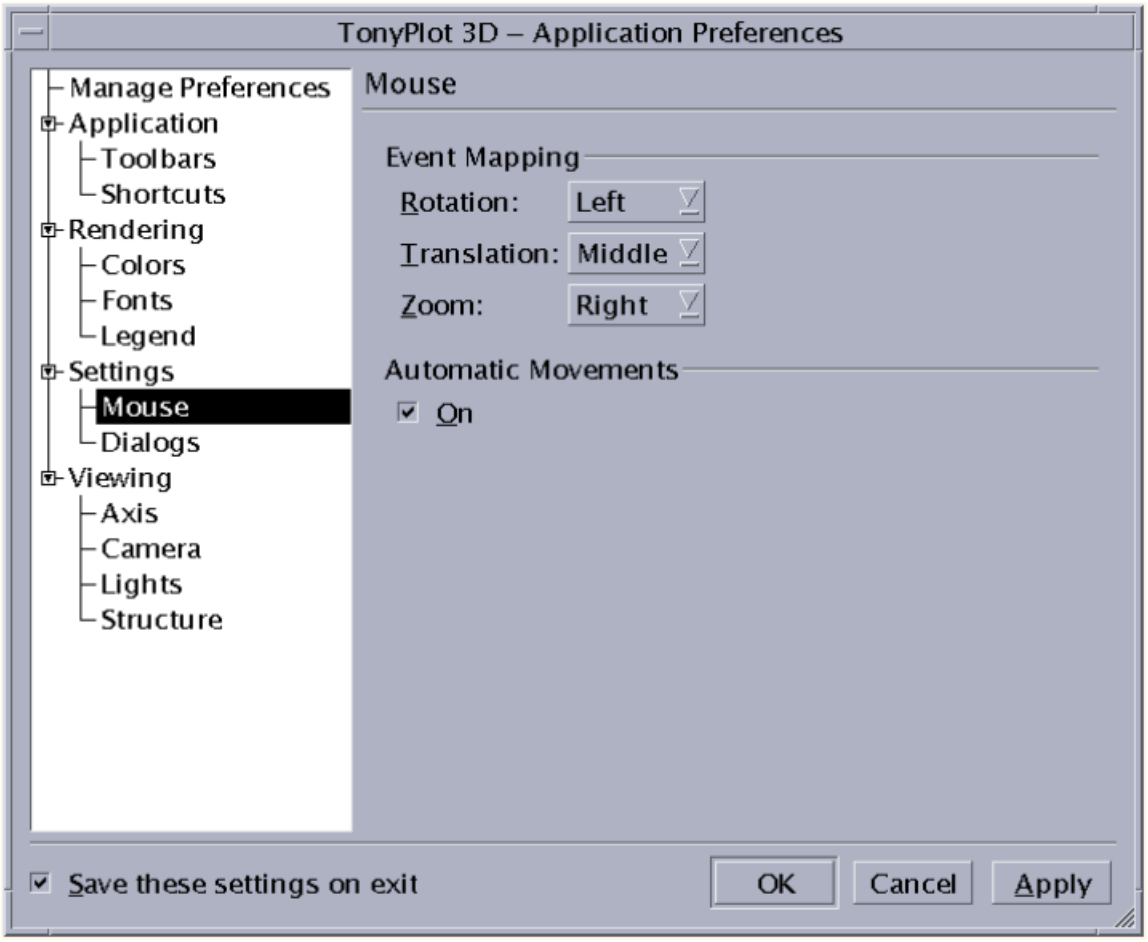


Figure 2-34: Mouse Tab

2.5.5: Camera

The Camera Tab is shown in Figure 2-35. The Camera function controls the actual camera used to view the data.

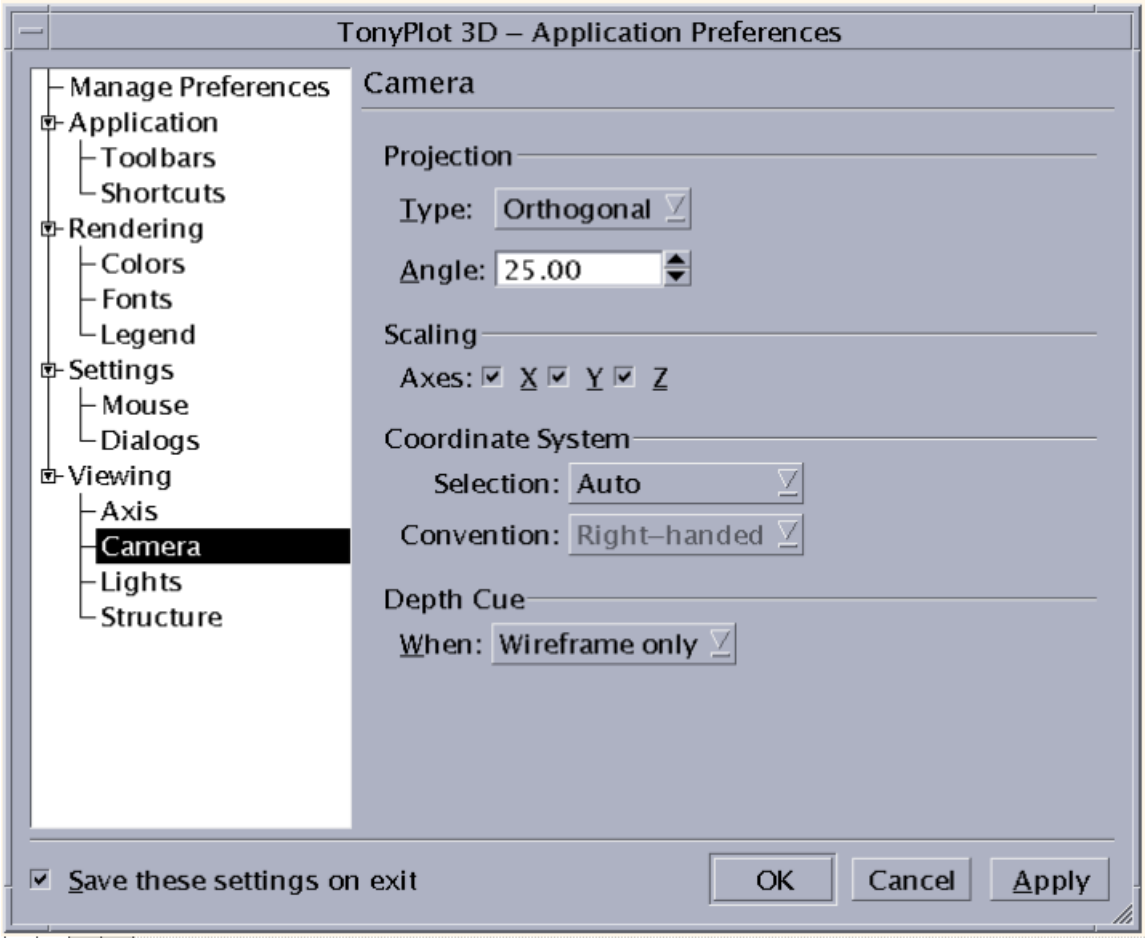


Figure 2-35: Camera Tab

Projection

This option controls whether or not the camera projects a perspective or parallel view. The angle of the projection can be changed when prespective is used

Scaling

This option effectively multiplies the coordinates of the structure to be viewed. You can set each axis that you wish to scale.

Depth Cue

Use this option to add more depth (realism) to the plot. Objects that are further away appear slightly dimmer than those that are closer. You can apply this option to the entire structure or just to the wireframe.

2.5.6: Lights

The light sources in this tab (Figure 2-36) are used to illuminate the scene. In this tab, you can toggle the lights themselves (**Light 1** and **Light 2**), change the color of the lights, and modify their intensity. The directional light sources are described by latitude (vertical) and longitude (horizontal).

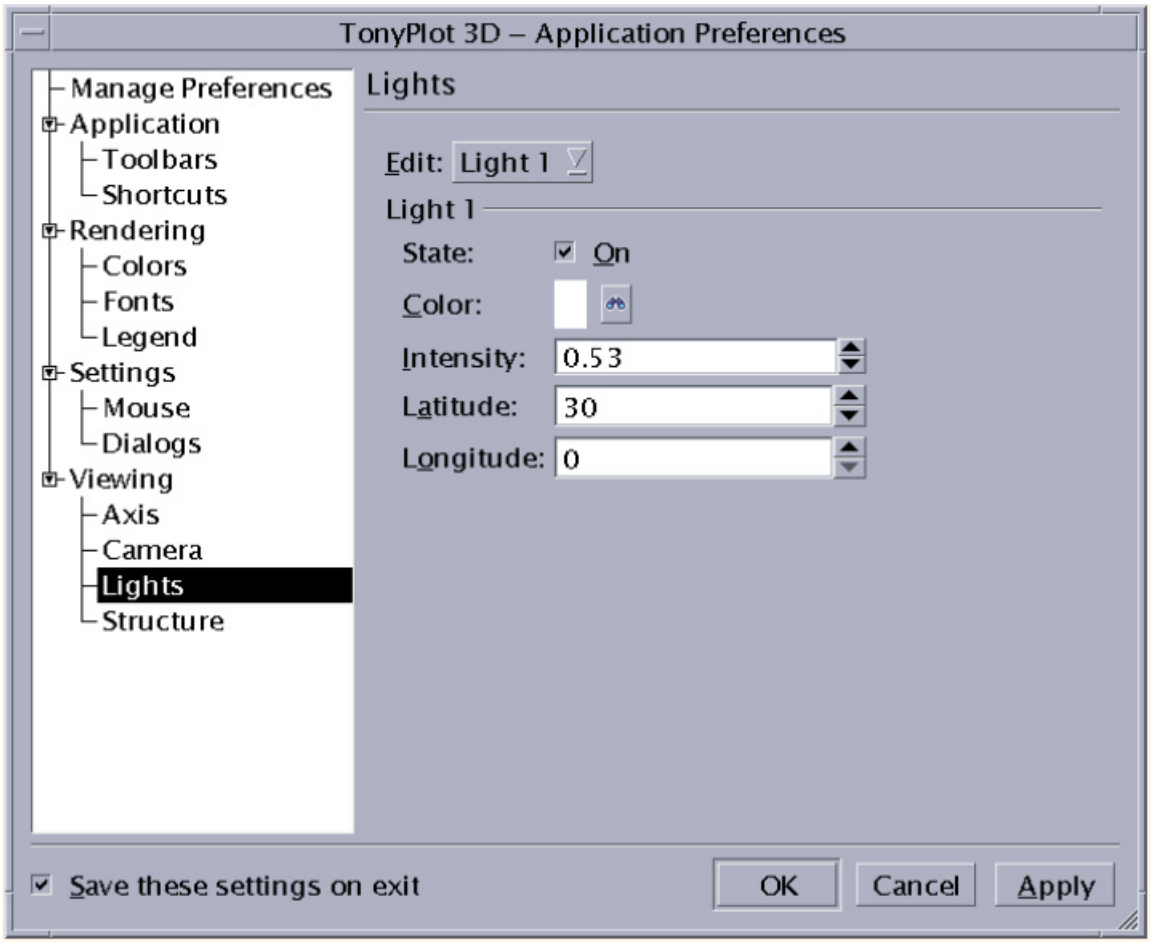


Figure 2-36: Lights Tab

2.5.7: Structure

This tab (Figure 2-37) can be used to adjust the display properties of the structure. It contains the following:

- **Outline Controls:** To use this function, you have to plot your structure in **Solid & Meshed** Mode and use the Contours with a **Stepped** option in the Legend instead of a **Linear** one. When activated, it draws lines between steps on the elements.
- **Mesh Width:** Adjusts the width of the mesh.
- **Transparency:** Adjusts the transparency of the display.
- **Drag Type:** Defines whether or not a bounding box is drawn when the object is moved.

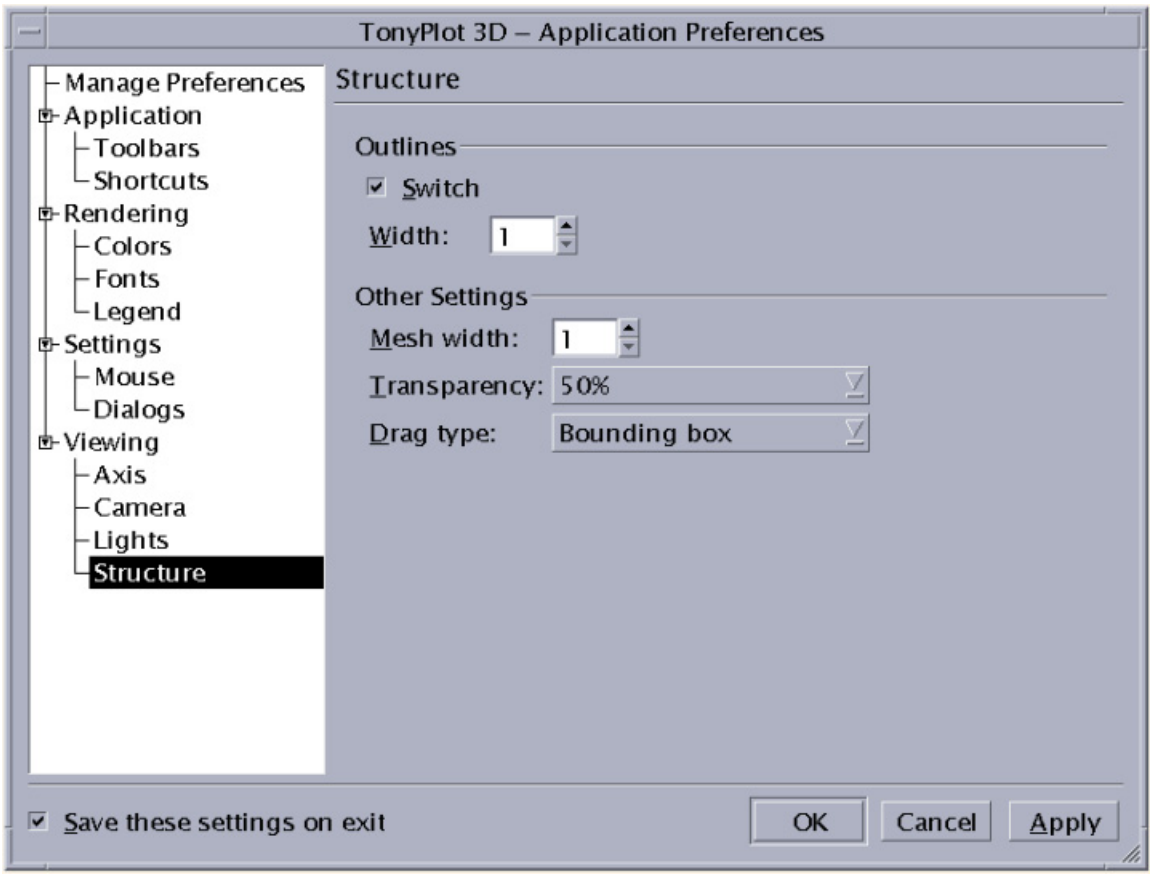


Figure 2-37: Struct Tab

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Appendix A: Operating Platforms

A.1: SunOS 5.x UltraSPARC and SPARCstations

A.1.1: UltraSPARC and SPARC-based Systems

TONYPLOT3D executes on Sun UltraSPARC and SPARC-based systems supported by SunOS 5.7 or higher.

A.1.2: Operating System

This version of TONYPLOT3D requires SunOS 5.7 or higher. The command:

```
/usr/bin/showrev
```

shows which operating system version is running.

A.1.3: Graphics Hardware

There are two ways of producing screen images. One way is a software renderer, which uses graphics primitives implemented in software. Another way is a hardware renderer, which uses native graphics hardware implementing the OpenGL API version 1.1 or higher.

The software renderer works on UltraSPARC and SPARC-based models with True Color frame buffers and an X server. You can use `xdpyinfo` to obtain information about the X server on your machine.

To run TONYPLOT3D without graphics acceleration, use the `-nohw` command line option.

The hardware renderer requires a True Color graphics adaptor that supports OpenGL API version 1.1 (i.e., UltraSPARC and SPARC-based systems using the TCX, SX, GX, ZX, PGX/PGX24/PGX32, Creator/Creator3D, Elite3D, or Expert3D/Expert3D-Lite framebuffer).

A.1.4: Memory

TONYPLOT3D requires a minimum of 128Mbytes of real memory. To improve performance, however, more memory, such as 256Mbytes or even 512Mbytes, is strongly recommended. To see how much memory your system has, use the command:

```
/usr/sbin/prtconf
```

`Memory size` is printed within the first few lines of output.

A.1.5: OpenGL Library

TONYPLOT3D is designed to work with OpenGL API version 1.1 or higher. Try the following web site for information on obtaining OpenGL drivers for your graphics hardware:

http://www.sun.com/software/graphics/opengl/

or contact the Techincal Support for your Operating System.

A.2: HP 9000/7xx Workstations

A.2.1: Workstation Models

TONYPLOT3D executes on any of the HP 9000 7xx series workstations that support HPUX 11.0.

A.2.2: Operating System

TONYPLOT3D for HP platforms requires the HPUX 11.0 operating system. The command:

```
uname -r
```

shows the current revision of the HPUX operating system running on your workstation.

A.2.3: Graphics Hardware

There are two ways of producing screen images. One way is a software renderer, which uses graphics primitives implemented in software. Another way is a hardware renderer, which uses native graphics hardware implementing the OpenGL API version 1.1 or higher.

The software renderer works on workstations with True Color frame buffers and an X server. You can use `xdpyinfo` to obtain information about the X server on your machine. To run TONYPLOT3D without graphics acceleration, use the `-nohw` command line option.

The hardware renderer requires a True Color graphics adaptor that supports OpenGL API version 1.1 (i.e., the Visualize fx5 and fx10 graphics cards).

A.2.4: Memory

TONYPLOT3D requires a minimum of 128Mbytes of real memory. To improve performance, however, more memory, such as 256Mb or even 512Mbytes, is strongly recommended. To determine how much memory there is in your HP workstation, log in as "root" and enter this command:

```
/etc/dmesg
```

This generates a list of various system messages that were produced when your system was rebooted last. Look for a message like the one shown below.

```
Memory Information: Physical: 98304 KBytes
```

A.2.5: OpenGL Library

TONYPLOT3D is designed to work with OpenGL API version 1.1 or higher. Try the following web site for information on obtaining OpenGL drivers for your graphics hardware:

http://www.software.hp.com/

Then, choose **search**, **request OpenGL**, or contact the Techincal Support for your Operating System.

A.3: Linux RedHat (PC Compatibles)

A.3.1: PC Models

TONYPLOT3D executes on any PC Compatibles that support Linux RedHat 7.2 or higher.

A.3.2: Operating System

This version of TONYPLOT3D requires Linux RedHat 7.2 or higher.

A.3.3: Graphics Hardware

There are two ways of producing screen images. One way is a software renderer, which uses graphics primitives implemented in software. Another way is a hardware renderer, which uses native graphics hardware implementing the OpenGL API version 1.1 or higher.

The software renderer works on any PC compatibles with True Color frame buffers and an X server. You can use `xdpyinfo` to obtain information about the X server on your machine. To run TONYPLOT3D, without graphics acceleration, use the `-nohw` command line option.

The hardware renderer requires a True Color graphics adaptor that supports OpenGL API version 1.1.

A.3.4: Memory

TONYPLOT3D requires a minimum of 128Mbytes of real memory. To improve performance, however, more memory, such as 256Mb or even 512Mbytes, is strongly recommended.

A.3.5: OpenGL Library

TONYPLOT3D is designed to work with OpenGL API version 1.1 or higher. Contact your graphics hardware vendor for information on obtaining OpenGL drivers for your graphics card.

A.4: Windows NT/2000/XP (PC Compatibles)

A.4.1: PC Models

Currently, TONYPLOT3D is not officially supported on Windows NT/2000/XP. But, TonyPlot3D will execute on any PC Compatibles that support Exceed or Exceed XDK version 7.1 (7.1.0.1 for Windows XP) or higher with the Exceed 3D add-on. Exceed 3D allows you to display OpenGL-based 3D applications using the Exceed X server by providing support for the GLX extension.

A.4.2: Operating System

This version of TONYPLOT3D requires Exceed or Exceed XDK 7.1 (7.1.0.1 for Windows XP) or higher with the Exceed 3D add-on.

A.4.3: Graphics Hardware

There are two ways to produce screen images. The first way is to use a software renderer, which uses graphics primitives implemented in software. The second way is to use a hardware renderer, which uses native graphics hardware implementing the OpenGL API version 1.1 or higher.

No software renderer has been provided by SILVACO for Exceed on Windows NT/2000/XP.

The hardware renderer requires a True Color graphics adaptor that supports OpenGL API version 1.1. You can use `xdpyinfo` to obtain information about the X server on your machine.

A.4.4: Memory

TONYPLOT3D requires a minimum of 128Mbytes of real memory. But for better performance and more memory, we strongly recommend 256Mb or 512Mbytes.

A.4.5: OpenGL Library

TONYPLOT3D is designed to work with OpenGL API version 1.1 or higher. Contact your graphics hardware vendor for information on obtaining OpenGL drivers for your graphics card.

Contact Hummingbird for information on getting Exceed 3D for Windows NT/2000/XP at www.hummingbird.com.

Index

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